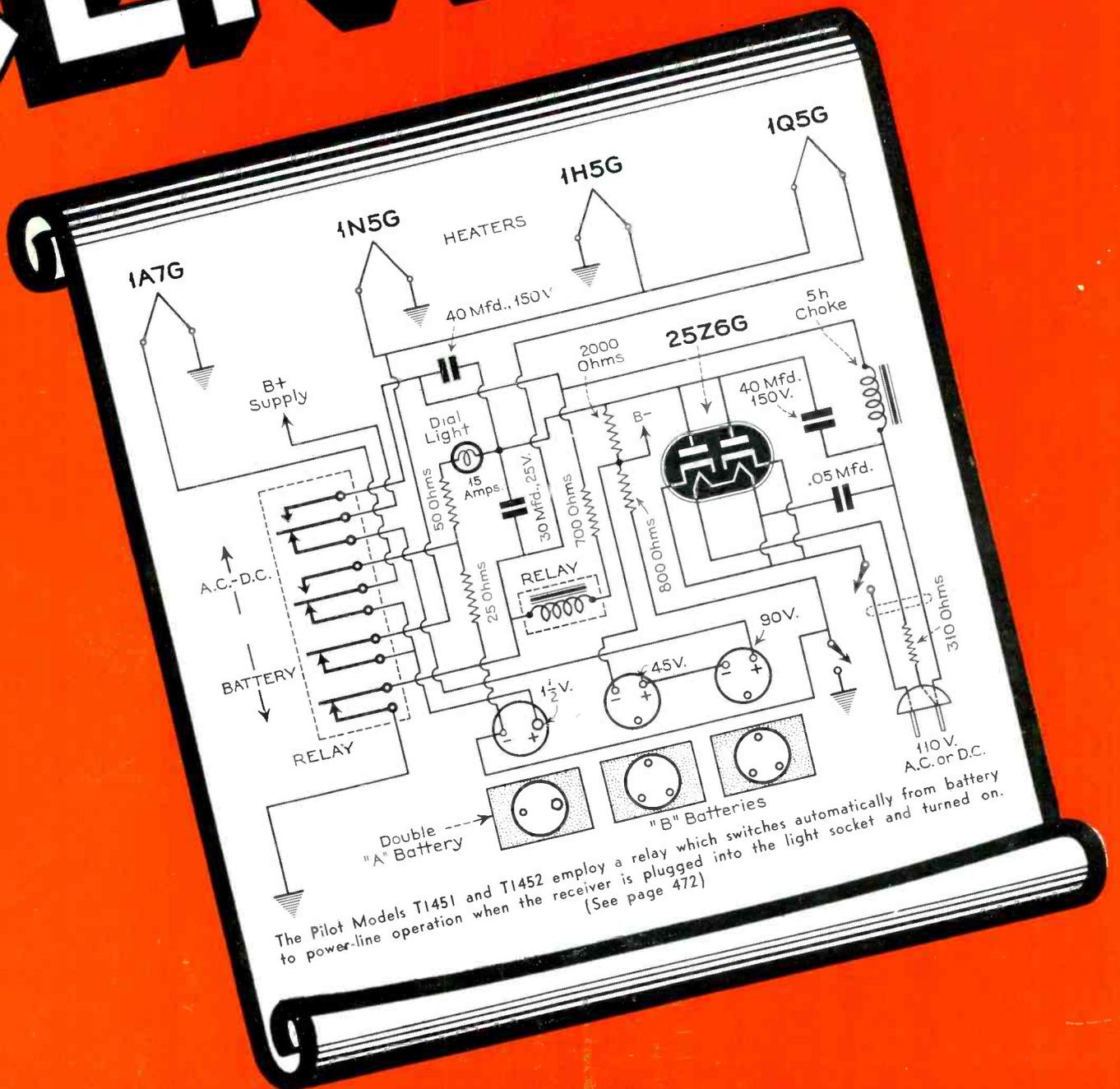


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October  
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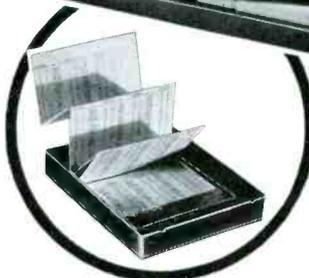
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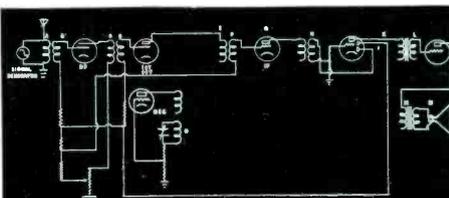
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## ANTENNA

**W**ITHIN the past few weeks the tube manufacturers have cleaned house. Inflated list prices have been brought down and a price structure established which is simple and based upon a sound relationship between manufacturing costs, distributor net prices and suggested list prices. The new setup should go a long way toward stabilizing the industry. Although some of the manufacturers have been pursuing a similar policy for some time, we feel sure that general conformity will prove more profitable for all concerned. It is our hope that the better conditions which should result will induce other manufacturers of component parts to clean house.

**I**F YOU had the time and money to enable you to travel from one factory to another, peek into the laboratories and find out what's new and how it works, you would indeed be able to keep up to the very minute. Yet, strangely enough, you can do just that while remaining at your bench within your own shop. All you have to do is to turn to the pages of new products and new literature published each month in **SERVICE** and write for the various catalogs and bulletins. Manufacturers spend thousands of dollars annually to inform you about their products. A brief note on your letterhead is all that is necessary to bring this wealth of essential information to you.

**S**ERVICE MEN everywhere are reporting marked response to the "Curtain Raiser" program sponsored by the NAB-RMA Joint All-Radio Campaign during the week of September 24.

That this is a step forward, as far as you are concerned, goes without saying. However, on page 470 of this issue, Mr. D'Arcy tells you just where you stand today as compared with the "good old days". The Service Man has finally gained recognition as a vital link in the powerful radio industry chain. It is our belief that this recognition can be attributed to national organization on an effective scale.

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R-53	Plate and mike to grid	3:1 and 17:1 ratio	1.65
R-56	1 plate to 2 grids	2:1 ratio	1.50
R-57	1 plate to 2 grids	2½:1 ratio	2.50
R-36	Driver	30, 49, etc. to class B 19, 49, 79, 89 grids	1.50
R-37	R. F. Output	Class B 19, 49, 79, 89 plates to 3500 and 5,000 ohms	1.60
R-58	5 watt Universal output	Any single tube to any voice coil .1 to 30 ohms	1.10
R-36A	6 watt Universal	Any tubes up to 6 watts to any voice coil .1 to 30 ohms	1.25
R-59	10 watt Universal	Any tubes up to 10 watts to any voice coil .1 to 30 ohms	1.40
R-60	15 watt Universal	Any tubes up to 15 watts to any voice coil .1 to 30 ohms	1.50
P-39	10 watt line Matching Transformer	250, 500, 1,500 ohms to 2, 8, 15 ohms	1.60
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# PUBLIC ADDRESS AND THE NEW YORK WORLD'S FAIR

By S. GORDON TAYLOR

WHILE acres of paper have been used in descriptions of various features and angles of the New York World's Fair there has been little published on the subject of its sound equipment, and this little has been concerned entirely with three or four outstanding installations of gigantic proportions. It is felt that an article covering the situation from the angle of the Service Man who gains a livelihood from selling sound installations is definitely needed—an article conveying some idea as to the important part that sound systems play in this gigantic enterprise, and pointing out some of the novel applications disclosed by several visits to this tremendously impressive extravaganza which occupies 1,200 acres of the Flushing meadows on Long Island.

• • • statistics

First of all it may be well to get down some statistics on sound equipment at the Fair.<sup>1</sup> The original figures were compiled in the middle of the Fair's run and have been expanded slightly by estimate to include equipment added since that time—therefore the round numbers.

That the Fair provides the world's greatest concentration of public-address equipment is indicated by the fact that

its 250 systems in 154 exhibits and concessions, utilize 700 amplifiers. There are just over 400 microphones in use, 105 record players, 34 sound on film units and 20 televisors, in addition to an unknown number of radio, television and facsimile receivers, etc. The original survey figures showed well over 1,000

speakers but during the progress of the Fair so many were added to provide increased coverage that it is believed the number now exceeds 2,000.

Of the 700 amplifiers in service over 95% are of standard manufacture, 3% were custom built by Service Men and 1% were built up from standard kits. Thirty-one amplifier manufacturers are represented but 83% of the equipment is the product of seven of these manufacturers.

The survey discloses that 51% of the systems are used to describe, explain or demonstrate exhibitors' products. On the other hand, ballyhoo operations account for only 20% of the installations although ordinarily one thinks of ballyhoo as the life-blood of a fair or carnival. This discrepancy is largely accounted for by the fact that this type of outdoor sound system is permitted only in the amusement areas.

The other 29% of sound installations include those used purely for entertainment, 7%; educational, 13%, and sound effects, 9%.

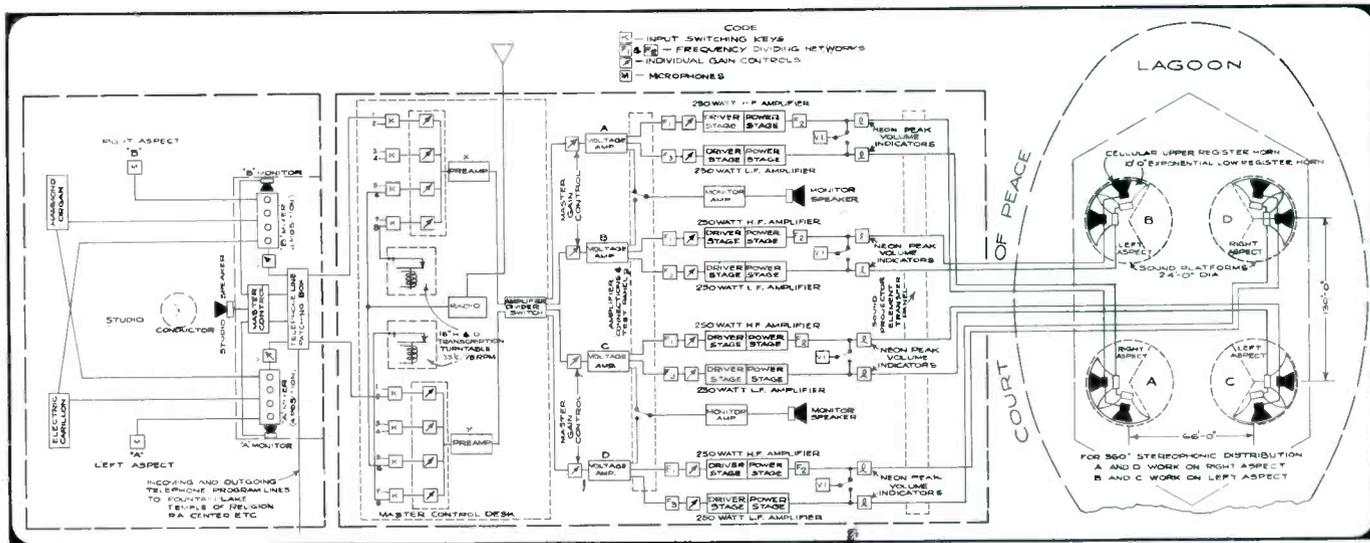
• • • standard equipment predominates

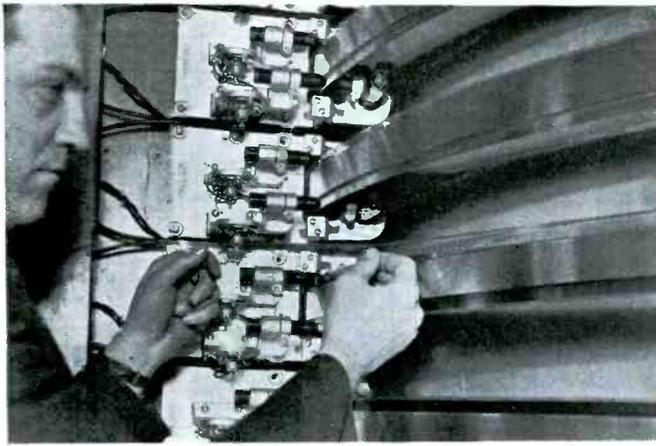
A general impression seems to prevail that the sound systems at the Fair utilize a great deal of specially designed equipment. This impression, probably created by the publicity that has been given to a few of the larger installa-



Figs. 1 and 2. Sound plays an impressive part in the great spectacle at the Lagoon of Nations where four groups of speakers, each group in its own 30-ft. pillbox, are capable of reproducing peak power of 2,000 watts.

<sup>1</sup>These data are presented through the courtesy of Radio Wire Television, Inc. (formerly Radio Service Co., Inc.) and are taken from an independent survey for that organization.





Figs. 3 and 4. At the General Motors' Futurama each visitor seated on the great conveyor belt hears only the portion of the description of the scene immediately before him. Those directly ahead or behind are at the same time hearing other portions. This is made possible by scanning the sound film at 150 points (left) along its length. Each pickup feeds an individual amplifier which drives tiny Cinaudagraph speakers on the seat-backs.

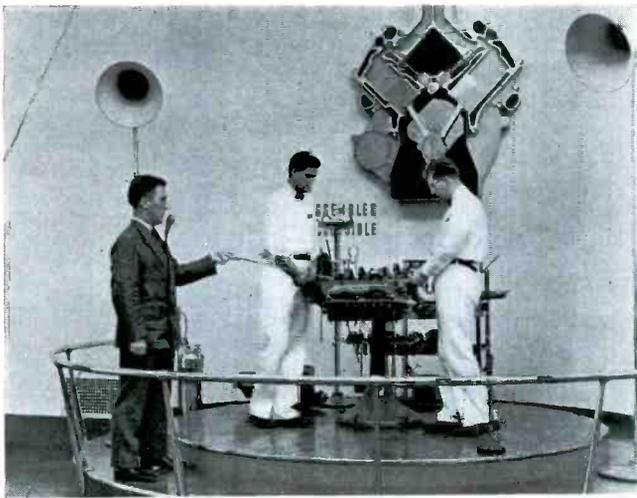


Fig. 9. Each exhibit in the great Ford and Chrysler buildings has its own individual sound system, thus combining simplicity with utmost flexibility. The photo above shows a Webster equipped system in operation in the Ford building. Below one of several Lafayette systems is pictured.



tions, is far from the truth. Probably 95% of all the sound equipment employed is regular stock equipment and generally available on the open market. What is more, it is estimated that about this same proportion of installations lie within the ability of the average Service Man to install. The systems that involve highly specialized engineering design could just about be counted on the fingers of one hand.

The real feature of the Fair's sound system, from the standpoint of the Service Man, is found in the tremendous variety and novelty of applications. Unfortunately space does not permit going into detail concerning all of these but the accompanying illustrations and text that follows are intended to provide a sort of panoramic view of sound at the Fair for those who were unable to attend in person, or who, beguiled by the grandeur of this great show were unable to bring themselves around to a study of such mundane things.

#### • • • 2000-watt stereophonic installation

The 2,000 watt Bludworth installation at the Lagoon of Nations is of interest not only in its more spectacular aspects but also in that it demonstrates a practical application of stereophonic (or binaural) reproduction which can be applied in smaller installations as well.

The Lagoon is the scene of a nightly spectacle in which fountains, lights, fireworks and music are all combined in one grand symphony of sight and sound.

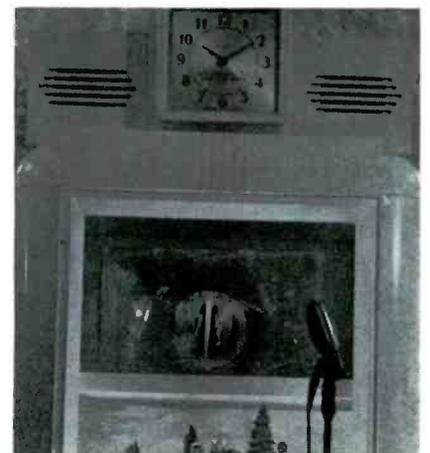
(See Fig. 1.) For utmost realism it was considered essential to have the music come from the heart of the spectacle. With a saturated atmosphere and literally tons of water falling from the fountains, however, the band could not be placed there. On the other hand a typical p-a system would limit realism due to the loss of sound perspective which distinguishes live music from normal loudspeaker reproduction.

T. Frank Bludworth, of Bludworth, Inc., conceived the idea of utilizing the stereophonic principle by placing a microphone on each side of a remotely located band studio and carrying the output of each through entirely separate amplifier systems to separate groups of speakers in the Lagoon. Thus the pickup coming predominantly from one side of the band would be heard coming from one end of the lagoon and that of the other half of the band from the other end.

The method used in accomplishing this plan is shown by reference to Fig. 2. Pickup from microphone A is reproduced through speakers A and D, which are placed at diagonally opposite corners of a rectangle in the center of the Lagoon. The output of microphone B is reproduced through speakers B and C.

Fig. 17. The figure in the ice is a real person but reduced to a 15-inch image by means of lenses. Her voice comes from the speakers overhead through the medium of a Bogen sound system. Later the beautiful model steps out and continues her talk from the mike in front.

Fig. 10. Bernays Johnson's "Radio Magic" show (left) utilizes a single sound system both for outdoor ballyhoo and as a feature of the show inside. The 6-110-volt amplifier (shown below) will be used in a trailer when the show takes to the road.



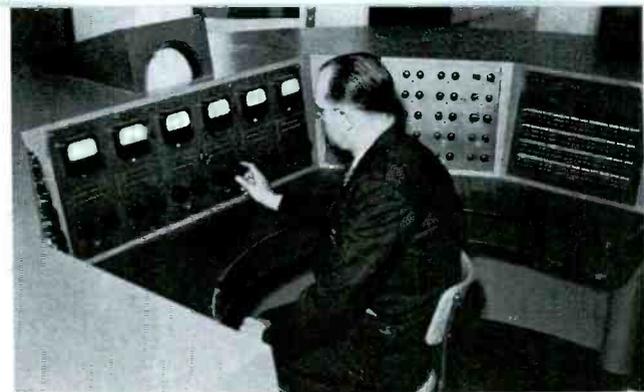
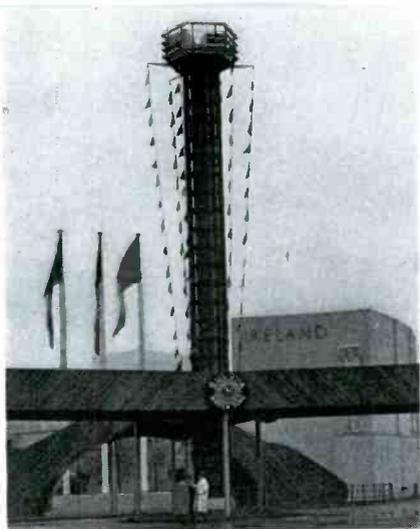


Fig. 6. The general Fairgrounds system utilizes a master control console (above) to provide selection and distribution of programs covering the outdoor area of the 1,200-acre site. RCA Twin-Power cubes (first column, left) and Cinaudagraph dual-baffled dynamics (middle column) are distributed throughout the grounds.

Thus a listener located at any point around the lagoon hears the two pickup components coming to him from different directions and in the normal perspective that would be experienced if the band were actually located out on the water.

For more complete realism this installation employs tremendous power and is capable of flat response (including speaker systems and lines) of 28 to 11,000 cps. Each of the four speaker groups consists of two Cinaudagraph, Model WPE-27 dynamic speakers with reinforcement of highs by four Western Electric 594A high-frequency units. Each of these Cinaudagraph units is capable of handling 85 watts continuously, weighs 495 pounds, and boasts a 6-inch voice coil and 27-inch cone.

Each speaker group is housed in a great cylinder 24 feet in diameter, entirely inclosed except for the mouth-openings of two great built-in exponential horns, each of which is approximately 15 feet wide by 8 feet high. One of these giant Cinaudagraph speakers is mounted in the apex of each horn while the two high-frequency units work into a smaller, cellular horn baffle mounted in the mouth opening of the larger horn.

• • • sound takes a ride

One of the most popular features at

the Fair is the unique General Motors Futurama<sup>2</sup>. Essentially this consists of a scale model of a countryside depicting highways of the year 1960, complete with mountains, rivers, buildings, motor cars, trains, etc. The model is 1,600 feet long and is traversed along one edge by an endless belt conveyor on which are mounted comfortable seats accommodating 600 spectators at one time. Some idea of this arrangement is shown in Fig. 3.

Interest in this feature is tremendously heightened by the provision of a running description of the panorama; the progress of the story so synchronized with the movement of the conveyor that each spectator hears only the portion of the story applying to that section of the panorama in his immediate view. This means that other spectators in seats a few feet ahead or behind are hearing different parts of the story corresponding to the portions of the scene before them at the moment.

To make this possible each seat has a small Cinaudagraph pm speaker and two-way baffle horn mounted on back at approximately ear level of its two occupants. The seat is of the bucket type with high back and wide sides, all heavily upholstered, which serve to confine the sound of the speaker to that seat

<sup>2</sup>The Polyrheter, By G. T. Stanton. COMMUNICATIONS, July 1, 1939, p. 10.

Fig. 5. The great Railroads on Parade show offers an excellent example of sound legerdemain. A soloist walks across the stage with no mike in sight, yet the song, although loud enough to be heard above the roar of a locomotive on the stage, is heard with excellent quality of reproduction and appears to be coming directly from the soloist's lips and follows him across the stage.

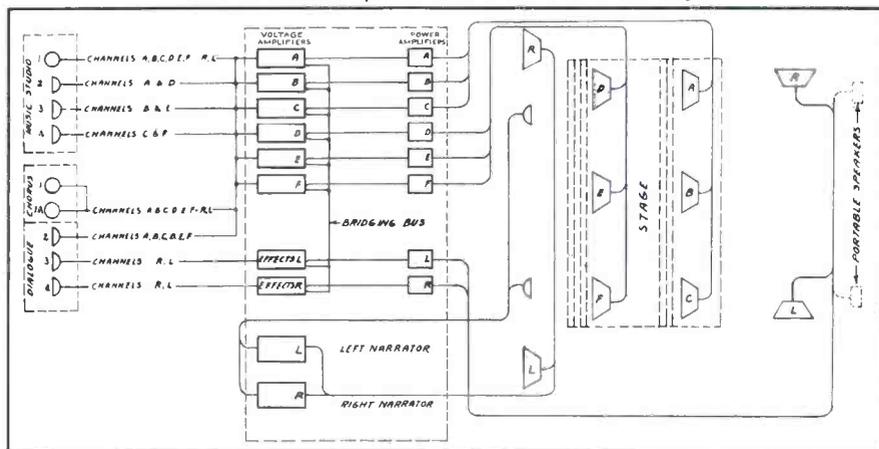


Fig. 11. Sound is localized in the installations at the Beechnut exhibits by projecting it directly down from overhead. Two methods of supporting the speakers are used, one in a canopy-like baffle (shown below), the other in individual decorative metal housings suspended from the ceiling (shown above). An Operadio amplifier with Garrard automatic record players are employed in each case.

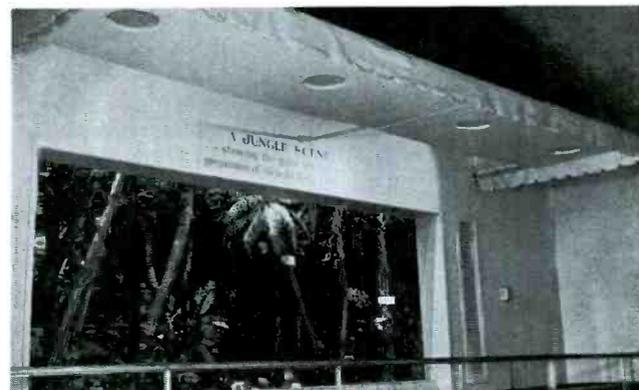


Fig. 16. Clothing dummy robots are made to talk and move, the movements of their lips and other parts perfectly synchronized with the speech by Robophone, a combination sound system and mechanical control device in which synchronism is insured by sound discs which carry both speech and controlling impulses.





and thus avoid interference with neighboring loudspeakers.

The description talk is recorded on 22 strips of film mounted on a revolving drum. This film moves past a bank of approximately 150 photocells evenly distributed over its length. Each photocell picks up a different portion of the description. A few of these, with their light sources are shown in Fig. 4. Each pickup feeds into its own amplifier, the output of which is fed to two of the seat-back speakers and is therefore audible to four spectators.

The amplifier outputs are fed to the corresponding speakers through a system of fixed rails beneath the conveyer which are contacted by shoes under the seats. This system, as well as that for maintaining perfect synchronization between the film and the conveyer are too complicated for description here but suffice to say that the mechano-electrical problem involved taxed the genius of the ERPI and Westinghouse engineers who collaborated in the design and installation of this unique sound system.

By this system the Futurama may be witnessed by up to 26,000 persons daily. The conveyer ride takes about 15 minutes to traverse the 1,600-foot model. The great belt moves continuously, spectators stepping off at the unloading platform as they would off an ordinary escalator and others taking their places at the loading platform a few feet farther on.

#### • • • tricks of sound

The great Railroads on Parade show with seating for 5,000 spectators, a 5-acre stage and a cast of 300 people, 40 horses and 15 real locomotives offers an excellent example of sound legerdemain. A soloist walks across the stage without a microphone in sight and nothing within fifty feet of him which might conceal one. Yet the song, although loud enough to be heard above the roar of a locomotive on the stage, is heard with excellent quality of reproduction and appears to be coming directly from the soloist's lips, following him as he moves around the stage.

This illusion is created by a p-a sys-

tem consisting of a number of speakers concealed about the stage with a control operator who can switch sound around from one to another at will. The lack of microphone is explained by the fact that the soloist on the stage is acting in pantomime—the actual voice comes from a singer in a sound-proof room below the grandstand, from which he watches his counterpart on the stage. In two such rooms are soloists, chorus and band, duplicating those which actually appear on the stage.

Fig. 5 shows a block layout of speakers, the eight main amplifier channels which are capable of 400-watts output when in simultaneous operation, and two lower power channels employed by narrators who piece together the episodes of this historical pageant. Because of the complication of the mixer wiring, with its 34 input positions, it is not shown, nor is the channel-switching arrangement. Two special overall sound



In the Chrysler "Talking Car" feature, operated by the vaudeville team of Parker and Green, the car's voice issues from its radiator. It answers questions from the audience and even wisecracks, although there is no visible wire connection to or from the car. How this is accomplished is a deep dark secret but the interlocutor uses a standard Lafayette system for his equipment.

effects channels have their own speakers mounted off-stage in such a position that only reflected sound reaches the audience, thus providing a highly diffused general background.

This system of coupling sound with action and without any physical evidence of a sound system is the development of the C. C. Langevin Co. of New York, designers of the entire installation. The equipment used is Western Electric throughout.



#### • • • general fair system

Perhaps the most comprehensive and flexible public address distribution system in the world is that of the Fair itself. An RCA installation with its control position in the Communications Center Building, its pickup system extends to points throughout the fairgrounds as well as outside. Its output provides coverage of the entire outdoor area of the grounds and in addition lines extend outside to permit local and nationwide broadcasts of events and programs staged in the four studios at the Center and elsewhere on the grounds.<sup>3</sup>

The master control board for this gigantic layout (Fig. 6) closely resembles those found in the larger broadcasting stations. It performs all functions of selecting, controlling and distributing programs. In addition there are remote control boards at the Fair studios through which programs, live and recorded, are fed to this main console.

Some 39 power amplifiers are utilized in this system with 24 speaker units or groups distributed around the grounds. Two types of loudspeakers are employed. One is the RCA Twin Power cube (Fig. 7) installed either in the outside walls of buildings or on giant pedestals. The other type is a Cinaudagraph pm dynamic unit (Fig. 8) with two-way baffle bells which project sound from both front and back of the cone. These latter units mounted atop steel poles, are used extensively along the roadways where advantage is taken of their semi-directional characteristics to project sound along the road but restrain it from causing interference within nearby buildings.

#### • • • simple systems favored

The large installations discussed thus far have been of rather specialized de-

<sup>3</sup>Radio at the Fair, by J. G. Sperling, COMMUNICATIONS, May 1939, p. 5.

# SUPREME

## SHORT CUT TO SERVICE

# PROFITS

### MODEL 504 Does It All And Does It RIGHT

**ACCURACY:** The 504 has an overall guaranteed accuracy of 2% on all D.C. and 3% on all A.C. functions. SUPREME guarantees the ENTIRE instrument to be accurate, not just one component part. New "Perma-Grad" TEMPERATURE compensated circuit assures this accuracy summer OR winter. This is an EXCLUSIVE feature.

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**2-WAY PROTECTION AGAINST OBSOLESCENCE:** There are two ways in which a tube tester can become obsolete: (1) a change in tube base arrangements and (2) a change in filament voltage.

The 504 has a "PATENTED DOUBLE FLOATING FILAMENT RETURN SELECTOR" which AUTOMATICALLY re-connects every tube socket to the proper arrangement while the instrument is being set-up according to the tube chart. This is done REGARDLESS OF PRESENT OR FUTURE TUBE BASE CONNECTIONS. There are now about 120 different bases—the Model 504 does not care if there are 1000 or more.

The 504 has also licked obsolescence due to high filament voltages by using the SUPREME VARIVOLT FILAMENT SELECTOR CIRCUIT which makes possible ANY filament voltage from 1.5 to the full line voltage. Arrow-way test system, set controls from left to right—just follow the arrows.

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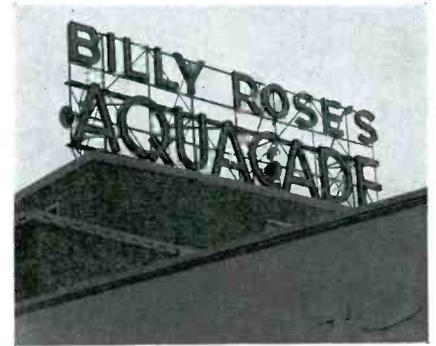


Fig. 12. Billy Rose's Aquacade employs dual ballyhoo. Four trumpets on the roof bring crowds from afar. A small local system at the ticket office (left) provides the final urge that carries these customers through the gates.

sign. Such installations, however, represent a very small percentage of the total. Even many of the other apparently extensive sound projects are quite standard and involve no great problems.

In the Ford exhibit, for instance, the installation comprises 26 amplifiers, 25 microphones and over 30 speakers. Yet this includes 23 small individual systems each consisting of a Webster Type FEX18 amplifier, floor-stand speaker and a breast-plate microphone, for applications such as that shown in Fig. 9. In these there are no complications whatsoever. The microphone, speaker and amplifier are close together and operate as a completely independent system. The balance of the equipment is utilized in connection with musical programs in a great outdoor court, with remote speakers and amplifiers in two private lounges and telephone line connections to enable broadcast stations to pipe the music out to their studios. This equipment is all standard, using Webster amplifiers throughout.

Frank Buck has found that a running commentary on the animals during an act lends much to the interest of the audience. His show and zoo employ two Clarion systems.



### • • • coverage patterns

Speaker angles play an important role in many installations. In some it is desirable to diffuse the sound to the greatest possible extent, but in others definite directional characteristics are important. Thus in the amusement area the ballyhoo systems at sideshows usually employ two speakers mounted on the front corners of the building and facing away from each other sufficiently to provide coverage up and down the midway, and avoid uncomfortable sound intensity directly in front where the customers have been attracted to watch the outside show which constitutes the come-on. Such an arrangement, typical of the amusements, is shown in Fig. 10.

In many of the exhibits, on the other hand, it is desirable to confine the sound to an area directly in front of the feature, avoiding interference with other exhibits nearby in the same building. Perhaps the most common way of doing this is to use one or two speakers, aimed in the desired direction and with just enough output to cover the desired area. This arrangement is typified in the installations of Fig. 9.

A less usual but highly practical arrangement is that employed in the Beechnut Products Building, as shown

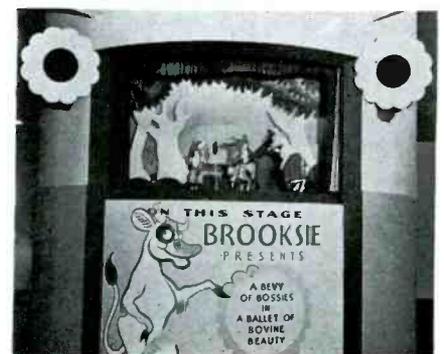


in Fig. 11. Here there are several Operadio sound systems operating simultaneously in the various parts of the exhibit, each with its own separate descriptive talk. To avoid conflict with one another the speakers of each system are mounted just a few feet above the heads of onlookers and pointed directly down. By using very low power each speaker provides coverage of only a very limited area of floor space, but with a suitable number of speakers any required area can be effectively covered.

Other variations are numerous. At Billy Rose's Aquacade, for instance, the main ballyhoo system utilizes a 70-watt Lafayette amplifier with four 6-foot trumpets driven by Cinaudagraph units. With such power severe discomfort would be experienced if nearby areas were within the direct field of the speakers. Moreover, the immense size of the Aquacade provides its own visual ballyhoo for everyone within a block or so of it.

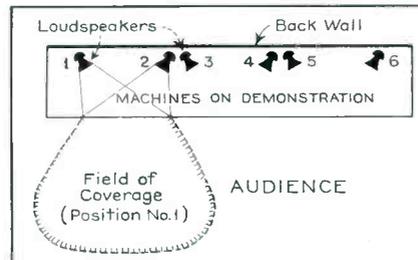
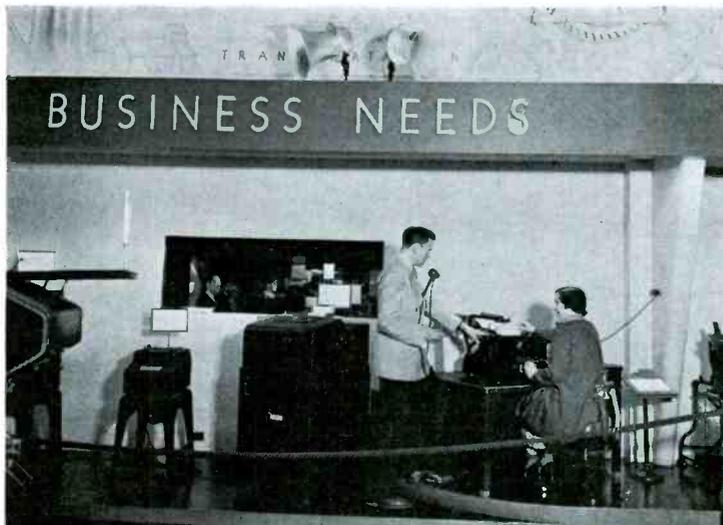
The trumpets are therefore mounted atop the great sign a hundred feet or so above the ground level as seen in Fig. 12. Moreover, they are tilted down only slightly. In this way sound is directed out over the nearby buildings to distant points so effectively that the ballyhoo is

Puppet shows play an important part at the Fair. Here are two which illustrate the extremes—life size dancers at the Fair's largest dance place, the Savoy (left), and the tiny figures on the 4-foot stage of the Swift exhibit. Both use Lafayette systems.





Figs. 13, 14 and 15. A single amplifier serves in the Remington-Rand business machines exhibit. Jacks along the wall accommodate the mike and automatically switch in suitably placed speakers (right). In another part of this exhibit a noiseless typewriter is demonstrated in a sound-proof glass room and compared with a standard machine (shown above). The sounds are brought out through a speaker and the noise contrast visually indicated on the oscilloscope mounted on the back wall.



easily audible a half-mile or more distant, even above the high noise level prevailing throughout the amusement area, and no discomfort is experienced either by the public or other exhibitors nearby.

In the Remington-Rand exhibit, also Lafayette equipped, the problem of demonstrating a long line of business machines without conflict between descriptive talks was solved in another manner. Here attention is concentrated on one machine at a time (Fig. 13) and is centered by directing the sound over an area immediately in front of this machine. For this purpose the sound is provided by a single amplifier with its microphone input circuit wired to several jacks mounted along the line of machines. Six speakers are used, mounted in dome baffles, along the wall. As the demonstrator progresses along the line he plugs in his breastplate mi-

crophone at successive jacks and in doing so automatically cuts in speakers providing proper coverage for each particular demonstration. This is illustrated in Fig. 14, which shows the condition when he is starting his demonstration at one end of the line and with his microphone in jack No. 1. When he moves on to position 2, loudspeakers 3 and 4 are made operative, the field of coverage advances and the crowd moves along with it.

The advantage of this system is that the crowd is automatically kept close enough to each demonstration to give it concentrated attention, yet at the same time is kept circulating and in this way is enabled to cover the entire exhibit thoroughly, under expert guidance.

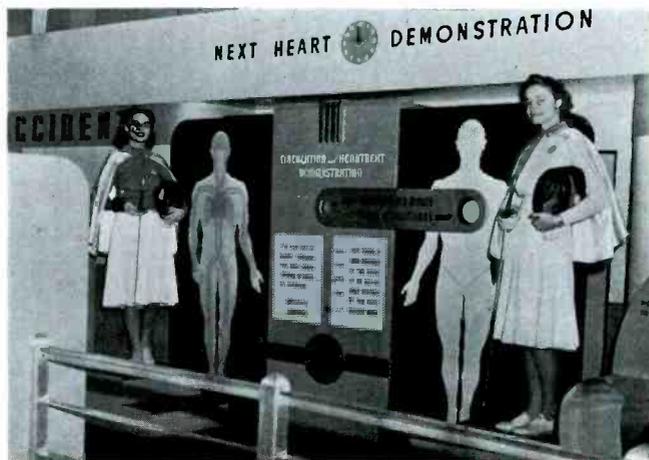
The Remington-Rand noiseless typewriter exhibit provides a highly practical solution of an otherwise insoluble demonstration problem. To show the advantages of a noiseless typewriter versus one of the standard variety is easy in a normally quiet room, but in an exhibition hall with its constantly high noise level this is something else again because even the standard machine will sound relatively quiet. A soundproof room was therefore fixed up, as shown

in Fig. 15, separated from the hall by a large glass window to enable the public to see inside. In this room, which is furnished as a private office, a skit is staged. An executive at his desk receives a telephone call, but is unable to hear the party at the other end of the line because of the clatter of his secretary's typewriter. He therefore has to ask her to remain idle while he finishes his conversation. In the next scene the same thing is repeated except that this time she is using a noiseless typewriter and, of course, it does not interfere with his phone conversation.

The sound system brings all of this  
(Continued on page 484)

One of the few custom-built sound systems at the Fair is the one employed in the exhibit of the Aetna Life Insurance and Affiliated Companies to demonstrate actual heart beats by means of speaker and oscilloscope, showing the effect of exercise on this organ.

The illusion created by the invisible glass window behind which this young lady stands is further enhanced through the use of a hidden mike and Lafayette sound system which brings her voice outside of the G. Washington Coffee lunchroom. Speakers mounted below the window frame utilize the concave outer surface of the glass to reflect the sound.



# HIGHER GOALS

By SAN D'ARCY

**T**HE National Association of Broadcasters' statement "the Service Man's activities are part and parcel of the industry's efforts to promote all phases of radio, new set sales and service . . ." forcibly indicates that at long last the Service Man is recognized as an extremely vital link in the billion dollar radio industry. To further express their faith in Service Men, NAB reports that "an increase in the number of radio stations cooperating in the year 'round campaign with the local chapters of the Radio Servicemen of America currently is being registered."

It is not strange that for nearly fifteen years such recognition has been either withheld or reluctantly given. Ten years ago the most reliable sources estimated that over 40,000 men were engaged in servicing, either full or part time, the 14,850,000 receivers then in operation. The ratio of Service Men to set owners was 1 to 371.

## • • • poor beginnings

It was easy for screwdriver mechanics to make money in 1929 and during the next few years when the depression became acute. Many receivers employed 12 to 15 tubes, and even a calloused faker who knew nothing about repairing radio sets could unblushingly ascribe the fault in any receiver to "a few defective tubes"—install these, pocket the few dollars—and seek a new sucker.

By 1934, the picture had changed in a few respects. There were, it is estimated, 26,000 men engaged in service work on a full-time basis and another 10,000 part time. The continued unemployment era accounted for the large number of part-time operators who still held on. Thus with 21,500,000 sets in operation, the ratio of sets to Service Men approximated 597 to 1.

As this is written the entire picture is completely altered. Even the most liberal estimates count only 16,000 men engaged in service work on a full-time basis. Perhaps, another 3,000 dabble in part time work. Yet there are over 40,000,000 receivers in home (or portable) operation with another 7,000,000 in automobiles. We now find the ratio of sets to Service Men approximates 2,473 to 1 as compared with 391 to 1 in 1929.

## • • • other transitions

In 1929 over 22,000 dealers, department stores and other retail establishments maintained their own service

departments. By 1934 the number dropped to 18,000. Meanwhile, independent service shops gained recognition and took over repair work formerly done by dealers' own service departments on a split fee or profit sharing basis. Today, this cooperative arrangement is more firmly established than ever before. Less than 7,000 retail stores and dealers operate their own service departments. In many small communities that support 8 or 9 radio retailers (including department, electrical supply,

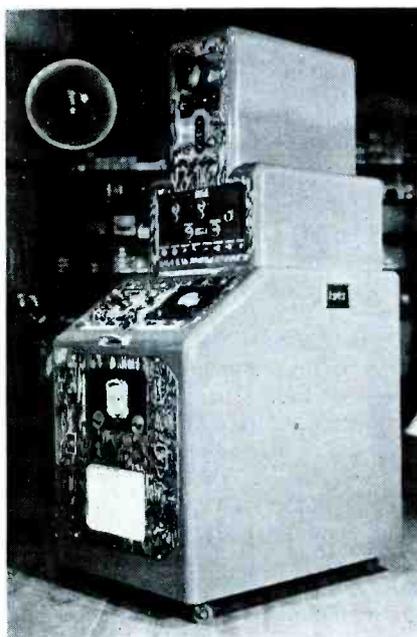


Photo courtesy Clough-Brenigle

The rolling Radio-X-Ray laboratory pictured was constructed by Ernest Moore, Ernest's Radio Service, Chickasha, Okla. Moore, like a majority of Service Men in the country, carries a substantial inventory of tubes and parts and is a well established figure in his community. In many instances Service Men are members of their local Kiwanis Club, Chamber of Commerce and similar civic organizations.

hardware, drug stores or cigar stores) 2 or 3 capable Service Men have cooperative arrangements for handling all repair work. These Service Men generally operate from their homes or from a service shop that does not include an inventory of radio receivers other than midgets or battery portables and they buy their parts from local distributors at established Service Men's discounts. Statistics indicate that the average Service Man who operates from his home maintains an inventory closely approximately \$900. Aside from instruments

and tools he generally carries a representative stock of fast turn-over component parts and tubes—also an automobile not included in this figure.

Service Men who operate stores or separate shops, according to statistics, carry an inventory just two and a half times as large—the difference being made up by an inventory which will include some receivers, electrical appliances and incidentals such as flashlights, batteries, electric fans, incandescent lamps, etc. In either case, whether the Service Man operates from his home or from a shop, he is in most cases a well established figure in his community and has a listed telephone. In other words, he is a small merchant and many are members of their local Kiwanis Club, Chamber of Commerce and similar civic organizations. Compare this figure with the transient Service Man of 1929 who, operating on a part time basis, could only be reached during the dinner hour or the night as otherwise he was engaged out on the streets seeking some means of full time employment. Of course, this floater generally had no business card and the classified phone book rarely listed him under the Radio Service classification.

## • • • constant improvements

So the position of those Service Men who have been able to survive these last few years has constantly been enhanced. In no small measure the development of ever increasingly complicated circuits has played its part. Today, a Service Man must be able to repair *any* and all sets regardless of vintage or circuit design to earn recognition in his community.

During the first nine months of this year over 30,000,000 tubes were sold as replacements. Service Men were point-of-contact and handled 70% of this volume or over 21,000,000 tubes. Before this year is over, Service Men will probably account for the sale of another 7,000,000 tubes for a grand total of 28,000,000 units during 1939. Present estimates indicate that only 13% of the total volume of tubes sold for replacement will be handled by retail establishments, mail order houses and all other outlets, while 87% will pass through the hands of Service Men engaged in service work primarily.

## • • • vital link

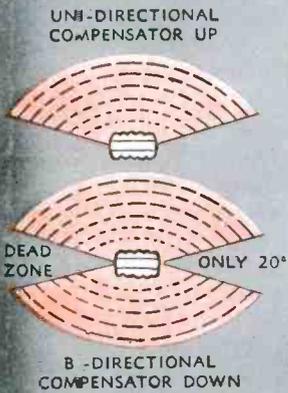
As stated in our opening paragraph, the vital importance of America's 16,000 Service Men in helping keep over 47,000,000 receivers operating efficiently, was finally recognized by the National Association of Broadcasters. It is well for NAB to support the very foundations upon which their structure rests.

(Continued on page 485)

Only

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# RECEIVER TRENDS FOR 1940

By HENRY HOWARD

(See Front Cover)

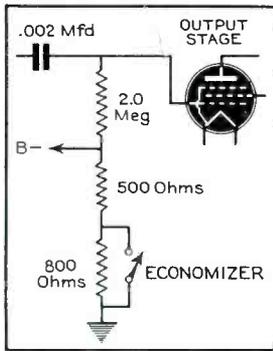


Fig. 5. The Economizer in the Pilot T1021 increases the bias on the power tube to save B current.

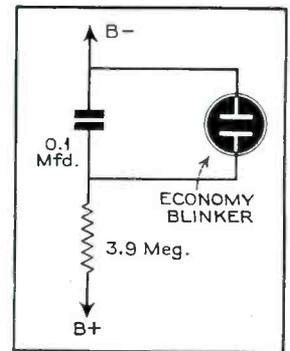


Fig. 7. The Economy Blinker in the RCA BT42, across the B battery, illuminates the dial in these sets.

**H**ISTORY repeats itself, even in the radio industry. We are again witnessing a rise in the popularity of furniture combinations with radio tables, radio bookcases, radio secretaries, sponsored, among others, by Zenith. Voltage doubler power supplies are coming back, also by Zenith. We have with us once more some clock model sets of Majestic and Detrola. Magnetic phonograph pickups are also staging a comeback, some with ultra-midget step-up grid matching transformers for additional pep. We have headset adaptors in Stromberg-Carlson's Model 405, for both magnetic or crystal types. . . . Oh, yes, we have battery sets, aplenty!

We are glad to report further efforts in the industry towards standardization including speaker voice coils which now lie in the range between 2 and 6 ohms. Octal sockets are standardized at 1 15/16 inches between mounting centers. More and more sets are earning the approval of the Board of Underwriters, which is a healthy sign. Battery sets are included.

• • • parts

There are many noteworthy improvements in parts: wire-wound resistors have new ceramic coatings rendering them entirely waterproof; carbon com-

Fig. 2. Wilcox-Gay is pushing home recording with their model A70 portable Recordio.



position resistors are better all-round; they are smaller with better insulation. Glass is used on resistors and on wire by Clarostat and Lenz, adding considerably to the safety of all kinds of sets and equipment. Solar has a new line of improved wax-moulded tubular condensers. . . . Micamold has introduced their Kodacap, a 600-volt tubular which uses a treated cellulose derivative di-



Fig. 1. RCA U12 has a silent mercury on-off switch for automatically starting the turntable as the pickup is moved toward the record.

electric. . . . Mallory and Magnavox are specializing in fabricated plate types of electrolytics and Cornell-Dubilier, among others, specializes in an etched foil type. In general, all types of condensers have less leakage, higher voltage breakdown, less equivalent resistance, improved power factor, better by-pass action and a longer expected life. We hope the cardboard types used in the cheaper midgets will also come in for some of these advantages, especially the longer life expectancy.

Volume controls are better, smaller and cheaper with better tapers now available and ranges are extended as high as 20 meg. The old paper-ink surface is replaced with a fired-carbon coat on bakelite which has a longer life with less noise. Non-microphonic sockets for 1H5 detector-audio tubes in battery sets

are becoming popular. Speakers come in for their share of improvement with more and better permanent magnets. Alnico type magnet manufacturers have four types of alloy available for speakers known as red, blue, green and red dot magnets—for various price classes. For compacts, speakers are smaller with closer air gaps and higher pitched to give more apparent volume.

Sprague has a push-button switch assembly with the capacities all contained in one unit. Cornell-Dubilier has a new dual mica condenser for diode by-pass and r-f filter. New glove type tube shields have become standard. Slow-acting Littelfuses have been designed for reactive circuits where surges are large and steady-state currents much lower.

There is something new under the sun in switches and switching. RCA's Model U12, shown in Fig. 1, has a silent mercury on-off switch for automatically starting (or stopping) the turntable as the pickup is moved toward the record. Incidentally, another feature of this particular table model is that both 10- and 12-inch records may be played with the lid down, a decided advantage, we believe. On one of G. E.'s phonograph

Fig. 3. The A71 Wilcox-Gay Recordio console features a radio receiver as well as the recording outfit.





combinations there is a dual switch on the pickup, automatically switching off the radio end and starting the phonograph motor when the pickup is raised.

A new type of slide switch, approved by the underwriters, has been developed for a wide variety of uses including tone control and waveband switching, as well as for television audio and phono pickup input circuits.

• • • **phonographs and records**

Phonographs and the record business are booming. Prices have dropped and lower priced records are becoming available in order to reach the masses. New magnetic cartridge pickups have already been mentioned. Pickups by Webster all have dial lights in the head which light when combinations are switched for phonograph operation. The trend is definitely toward rim-driven motors. A variety of new, small, cheap rim-driven, shaded pole, constant speed motors are now available. A great advantage is the elimination of all gear noise. On d-c, vibrator converters are



Fig. 8. Decorative metal bars on speaker grills in true modern fashion are appearing on the Westinghouse WR172 and WR272.

being used to generate 60 cycle a-c, for operation of these motors.<sup>1</sup> These vibrators have been highly developed so that they are thoroughly reliable, creating a minimum of noise and having very good frequency regulation. SERVICE has shown a 2-tube 60-cycle oscillator<sup>1</sup> which is also suited to running many phonograph motors on 115 volts d-c. Wilcox-Gay is pushing home recording with their phonographs. Model A71 (Fig. 3.) is a large combination console for home use and Model A70 portable Recordio for portable use. See Fig. 2.

• • • **battery sets**

There is no let-up in battery receivers. The battery-power line combination sets are proving popular as all-the-year-round models for use on a-c or d-c line during the indoor season while using batteries for portable operation only. A new arrangement provides high power output for line operation. This is accomplished by using a real power tube and special tapped output transformer.

<sup>1</sup>Sync Motors on D-C, by M. E. Reslag, SERVICE, May, 1939, p. 229.

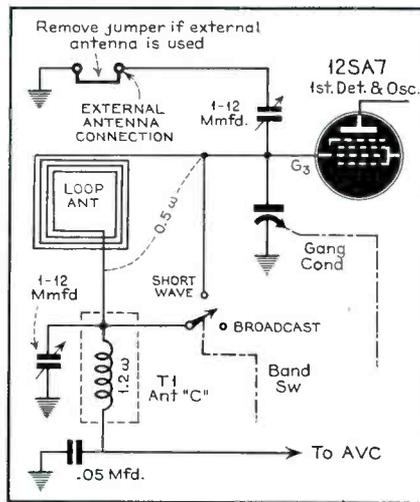


Fig. 14.—Wells-Gardner 6A27 features capacity coupling from antenna to loop.

The power tube, for reasons of economy, is combined with a half-wave rectifier, two tubes now being available—the 70L7 and the 117L7—the latter being the first line voltage heater available. Obviously a substantial speaker is required in these models. There are many new ingenious methods of increasing battery life through the use of clever

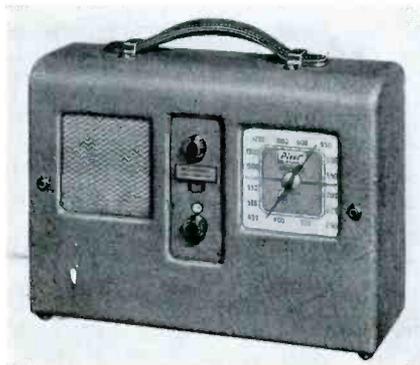


Fig. 4. The small switch midway between the two control knobs operates the Economizer in the Pilot T1021.

nick-nacks. Pilot has two ideas. In Model T1021 (Fig. 4) there is a small switch midway between the usual two knobs which operates the Economizer. When moved to the right, to Normal, maximum volume and sensitivity are obtained. When moved to the left, to Low, an 800-ohm resistor is inserted in the B-minus lead to ground (see Fig. 5), increasing the grid bias on the power tube which slightly decreases sensitivity and volume but cuts the current drain from the B batteries to about half. Of course, the quality must suffer somewhat, but, in some cases, the saving will be more important than the increased harmonics. The other battery saving stunt is a safety switch on the top of the panel. See Fig. 6. When the panel is covered when not in operation, the

switch opens the battery circuit. In Models T1451 and 1452 a relay is employed which switches automatically from battery to line operation when plugged into a power line. (See front cover.) Another feature is that, when used on line operation, the set starts immediately, being powered by the batteries until the rectifier tube warms up, at which time the relay throws over to power operation.

RCA has a neat pilot device to show when the set is turned on. Model BT42 has an Economy Blinker. This is only a familiar low period neon oscillator used in parallel with the B battery but does the job remarkably well. Fig. 7 shows the details of the system. The current drain through the 3.9 meg resistor is very low and can readily be considered negligible in practice.

As to trends in cabinet designs, decorative metal bars on speaker grills are appearing in true modern fashion. See Westinghouse WR172, WR272, Fig. 8. Other Westinghouse styles include table models with bent sides as in Model WR168, Fig. 9, and models with rounded tops known as waterfall tops as in WR169, Fig. 10. RCA Model T62 shows a distinctive style cabinet, a typical attempt to deliver something different. See Fig. 11. Note the one-piece escutcheons including push buttons on some of these models. European



Fig. 6. When the front panel in this Pilot set is covered, a switch opens the battery circuit.

dials with tables of data are appearing on some sets. The RCA Aviation Division's 6Q4 and 6Q4X are representative. (See Fig. 12.) RCA has several World's Fair models.

• • • **other trends**

The arrival of a new European war has stimulated interest in short-wave reception which ought to promote some service jobs. (Most owners previously haven't cared much whether the short-wave end of their sets was in working order or not.) It might also promote sales of new sets with emphasis on

short-wave performance. Tube sales should also be stimulated as the short-wave end always goes dead before the broadcast band when tubes start losing their normally high values of transconductance. The export departments have shifted their attention from Europe to South America which may change the wavebands somewhat in future export models. But long waves will still be used in American aviation. RCA's Pilot home receivers have already been mentioned. These sets permit high quality reception of conventional broadcasts as well as short-wave foreign broadcasts down to the 13-meter band. But they also cover the long-wave aviation beacon bands. Emphasis is placed on performance between 2000 and 6000 kc where plane intercommunication takes place. Thus, pilots and their families can keep in touch with everything that goes on in aviation. Aviation weather is given by beacon stations in between the beam signals although new stations are designed to give weather and beam information simultaneously. Filters in the receiver are required to separate the voice from the beam. Learadio, who specialize in radio equipment for planes, have a pilot's battery portable receiver which takes in the long-wave beacon band as well as standard broadcast.

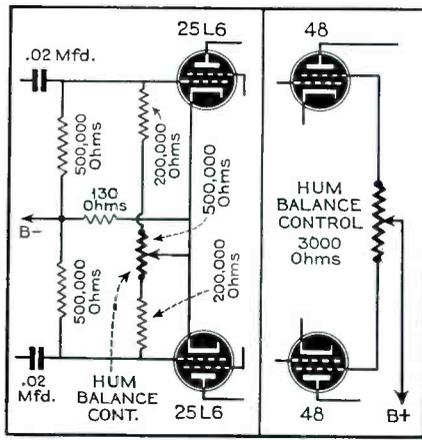
Zenith had the right idea in using



Fig. 10. Rounded Waterfall tops are a feature of the Westinghouse WR169.

a moulded chassis. Maybe they had advance information on the war and knew what would happen to steel! More cabinets and parts are being moulded all the time. Wood photo finishes are being used for two-toning.

The tendency is away from dual tuning knobs with various ratios, only single knobs are used. The trend is also away from complicated friction and other drive arrangements and toward a simple string cable drive. Those Service Men proficient in knitting or crocheting will be a jump ahead of others.



Figs. 15 and 16. Ansley has a hum balancing scheme which uses a potentiometer in either the control or screen grid circuit of final stage.

We note a conservative trend, too. All DeWald a-c models are using 6Y6s, 6K6s or 41s on 150 volts B, thereby eliminating many chances of voltage breakdown, especially in power transformers. Filter condenser life should be greatly prolonged also as plenty leeway is available. Less heat is generated within the set, too. There is a strong



Fig. 11. RCA T62 distinctive cabinet style is undoubtedly an attempt to deliver something different.

tendency toward the complete elimination of grid bias in all tubes except the power stage. The r-f tubes receive bias from the diode-detector-avc voltage and the first-audio tube is operated with the cathode directly grounded and the grid grounded through a very high grid leak resistance usually of the order of 10 or 15 meg. This system of operation is satisfactory only when the input level is very low—such as the output of a diode detector. In large sets, special function eliminators or noise gates may require individual bias systems.

In sets using loop antennas with two or more wavebands, separate loops are used in some cases rather than a single tapped loop. Fig. 13 shows Wells-Gardner 1A29 which uses two loops

and a loading coil for three-band operation. A noise gate, just mentioned under special bias, is also featured in this model. Antennas are usually coupled to loop sets inductively with a turn around the outside of the loop. Fig. 14 shows Wells-Gardner 6A27, which features capacity coupling from antenna to loop. Traveler mounts their loop trimmers right on the loop.

An absence of single tuned i-f transformers is noted; most new transformers use two trimmers. Ansley has a hum bucking or balancing scheme which uses a potentiometer in either the control grid or screen grid circuit of their phonograph amplifiers which might be applied to the final stage of a radio set as well. See Figs. 15 and 16.

### • • • tubes

Tube types are still on the increase. The present principal fields of activity are battery and combination line and battery portable tubes and also the 150 ma a-c, d-c series with more single-ended tubes and higher voltage cathodes or heaters. Just as a few examples, the

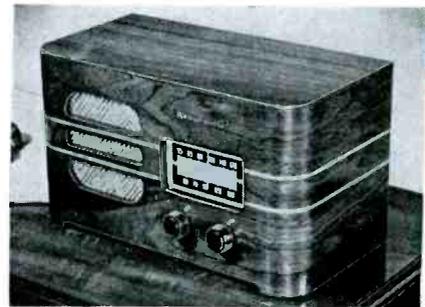


Fig. 9. Westinghouse WR168 table model cabinet has bent sides which give it stylish lines.

3C5GT is identical in many respects with the popular 1C5GT except for the filament which has two strands permitting either series or parallel operation. With the parallel connection, the tube draws 110 milliamps at 1.4 volts, just as the 1C5GT. However, when the filaments are operated in series, the current is then only 50 milliamps (the same as the other tubes in the set), but, of course, the voltage is doubled. It should be noted that, when the filaments are used in series connection, approximately 1.4 volts less bias is required as the increased filament voltage adds to the effective control grid bias. The 3Q5GT is a similar beam-power output tube with series or parallel filament arrangement. The 12SF5 is a single-ended metal type of high-mu triode similar to the 6SF5 except for the heater rating of 150 ma. The 70L7GT and 117L7GT are cathode type duplex tubes consisting of a beam-power amplifier and a half-wave rectifier in a single envelope. They are designed especially for use in small a-c,



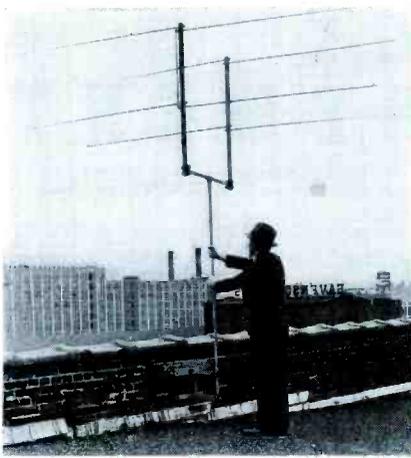


Fig. 19. A four-pole television antenna array, such as the RCA type shown, is used in localities with very high noise level and low signal strength.

d-c and combination battery and line receivers where space and heat dissipation are prime considerations. The 1T5GT is a beam power output tube intended for use in low-drain battery operated portables. The filament consumption is only 50 milliamps. The 1B8GT is a triple-purpose diode-triode detector audio voltage amplifier and output beam-pentode power-amplifier in one envelope. The primary purpose for the combination is for the conservation of space in portable compact sets, although there is an actual gain in audio output over the 1H5GT-1T5GT combination.

There is also a tendency to provide certain rectifier tubes to automatically supply the correct filament requirements for pilot lamps, in a-c, d-c sets. The 45Z5GT<sup>2</sup> is the newest member of this family. This system of operating pilot lamps does away with external resistors and, more important, prevents the filament-wrecking surge that occurs every time the set is turned on.

We can be sure that special purpose tubes will be ever appearing whenever a sufficient demand exists for them. The Bantam Jr. series of Hytronic Laboratories consists of a general purpose triode, a high gain, high impedance inter-stage a-f pentode and a power-output pentode. The principal applications of these ultra-midget tubes are for wearable hearing aids, portable pre-amplifiers, miniature compact receivers, remote control apparatus, meteorological instruments and sensitive measuring devices. We may expect even smaller tubes than these sooner or later for various novelties such as true pocket receivers as well as for the above range of applications.

It is interesting to note that the harmonic distortion in all the power-output tubes, beam and otherwise, is still between 7.5 and 11 percent and, more

commonly, the latter. While this is undoubtedly justified in portable and compact secondary receivers it is about time that improvements were made up the line. We hope the trend next year will be toward better quality—say, for instance, by the use of more push pull stages in medium-priced table models and low-priced consoles. With few exceptions, at present only the high-priced consoles and large table models are permitted push-pull output stages with their attendant high quality.

#### • • • frequency modulation

While considering quality we might as well bring up the subject of frequency modulation right here. It is interesting to note that this is an exclusive American development by Major Armstrong. There is no counterpart whatsoever in Britain or Europe. The new frequency modulated system employs the use of ultra-short waves and the signals travel only slightly beyond the horizon. This would allow many stations all over the country to operate on the same frequency, opening up an almost unlimited number of channels. Dr.

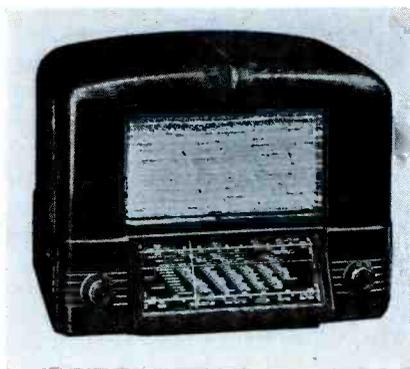


Fig. 12. The RCA Aviation Division's 6Q4 and 6Q4X employ European type dials with tables of data.

W. R. G. Baker of General Electric says that frequency modulated transmitters can be built for approximately one-fourth the cost of the usual broadcast station which should open up the market for a lot more customers. Since the characteristics of frequency modulation differ greatly from the conventional amplitude modulation and since most static acts like an amplitude modulated signal, the frequency modulation receiver picks up the new type of broadcast almost completely free of static. G. E. radio officials showed that 96 percent of existing static, both atmospheric and man-made, is eliminated from programs broadcast with the frequency modulated system. Also, when there are two or more interfering frequency modulated signals present in the receiver, no interference with the strongest signal will take place even though the interfering stations represent a considerable frac-

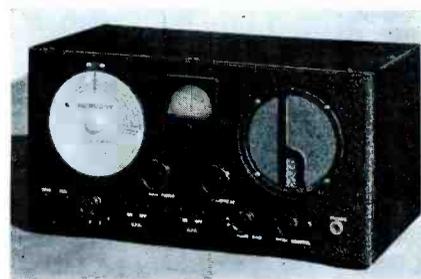
tion of the level of the strong station. Contrast that with our present system where even a very weak signal will produce a very annoying beat note.

Stations in New York, Boston and Schenectady are already on the air with frequency modulation. There will probably be a half-dozen or more during 1940. G. E. already has three models of receivers available, two of them equipped to receive only frequency modulated broadcasts, and a third (see Fig. 17) which also combines three-band radio reception of the conventional type. Outstanding characteristic of the new receivers, so far as the public is concerned, is their ability to recreate music and voice to an astonishingly life-like degree, with an almost complete absence of static and interference.

#### • • • television

With many new stations under construction and many more construction permits applied for, television is making great headway. With five or six principal receiver manufacturers having sets in the field, it remains only for the stepping up of broadcast schedules to put a lot of sets in the hands of the public. For a while, at least, transmission will take place only in the larger cities where a reasonable prospective audience will be located within range of the transmitter. This is an economic consideration, as a television transmitter represents a considerable investment. A number of manufacturers now have special television antennas on the market. Both RCA and G. E. have single, double and four-element arrays which, though not alike, represent general practice. A single dipole is sufficient where the receiver is close to the transmitter or where a good signal is received and no great amount of reflective interference or man-made static is encountered. A reflector is added when reflective interference produces ghost images in order to confine the received signal to one direction only. The reflector also increases the pickup. A four-pole antenna (Continued on page 489)

Fig. 18. Hallicrafter's Sky Buddy has 6 tubes, 4 bands, 44 mc to 545 kc, speaker, phone jack, avc and send/receive switches, separate band spread dial, beat oscillator with switch control and provision for d-c vibrator operation.



<sup>2</sup>New Tubes, SERVICE, March, 1939, p. 137.

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# FREQUENCY MEASUREMENT

By **GLENN BROWNING & FRANCIS GAFFNEY**

THESE are at least two general methods employed for frequency measurement. One depends upon the reaction from an accurately calibrated wave meter. The wave meter either indicates resonance on a vacuum-tube or similar voltmeter or gives a readable reaction of the frequency source.

The second method employs a heterodyne frequency meter. There are many variations to the general procedure. However, they all depend upon combining two frequencies, one of which is accurately known, in some type of mixer circuit and obtaining an audio beat note between the two frequencies. This method of procedure is comparatively simple and at radio frequencies the accuracy is extremely good. Unknown frequencies can be determined to 1 part in 100,000 or better. This article concerns itself with the latter method. It is believed that sooner or later the Service Man must have as part of his equipment some means of accurate frequency determination.

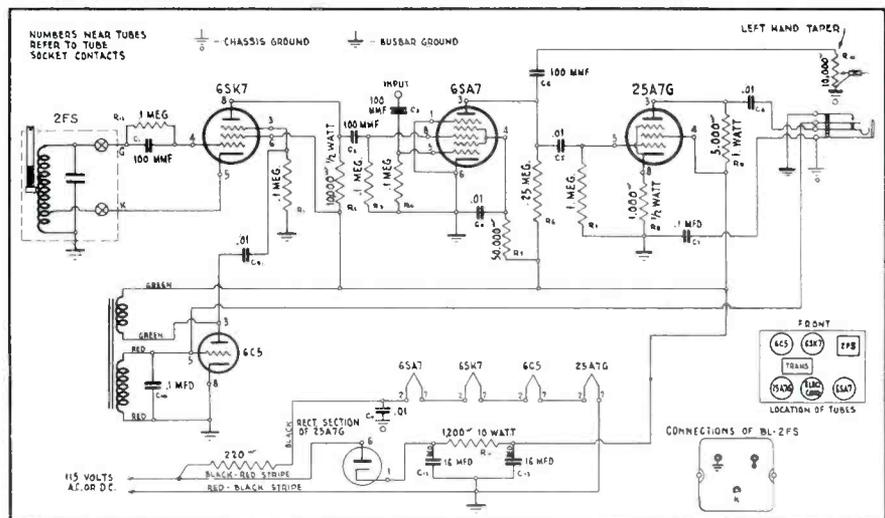
A very simple and inexpensive frequency standard composed of a 100- and 1000-kc oscillator, such as that shown in Fig 1, may readily be set with an accuracy of one part in 200,000 against the national Bureau of Standards station WWV, which transmits a standard signal accurate to one part in 5,000,000. Provision is made for either modulated or unmodulated 100- or 1000-kc standard frequencies, any of which are available by switching. The circuit utilizes a mixer tube so that a frequency from a

signal generator, oscillator or other device may be fed into the mixer tube and an audio beat note produced in the plate circuit. An audio amplifier and phone jack allow the beats to be heard readily.

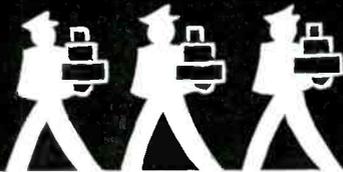
The wiring diagram of the apparatus is shown in Fig. 2. A 6SK7 is used in conjunction with a stable 100-1000-kc oscillator standard for producing the radio frequencies. The standard is an integral unit consisting of the two coils for 100 and 1000 kc respectively, together with their large silver mica condensers and a band switch for switching either of the coils into the circuit. The entire assembly is mounted in a shield can similar to those used for i-f transformers. Brass plungers are used for varying the inductance of both the 100- and the 1000-kc oscillators slightly and thus the standards may be set against WWV or any broadcast station. The procedure in this case is to tune to WWV and also impress the signal from the frequency standard on the antenna. When these two signals are picked up in the receiver, the resultant output is a beat note between the two, and this beat may be adjusted readily to within 25 cycles of zero, in which case the 100 and 1000 kc are at their respective frequencies to about one part in 200,000. Better initial accuracy may be obtained when extreme care is taken in the zero-beat adjustment. A 6C5 tube in an audio oscillator circuit is used for modulating either the 100 or the 1000 kc so that the apparatus may be used in place of a signal generator for particular applications.

By including a 6SA7 mixer tube and bringing out a terminal from one of the

Fig. 2. The Browning frequency standard utilizes a mixer tube so that a frequency from a signal generator or other device may be fed into it and an audio beat produced.



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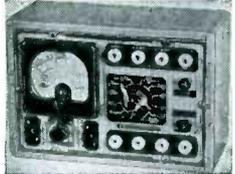
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grids of this tube, signal generators, oscillators, etc., may be calibrated accurately without the aid of auxiliary equipment.

• • • calibration

Let us assume that an accurate calibration of an oscillator or signal generator is desired. For purposes of illustration, we shall start with the signal generator adjusted to exactly 100 kc on its dial and proceed to check this point

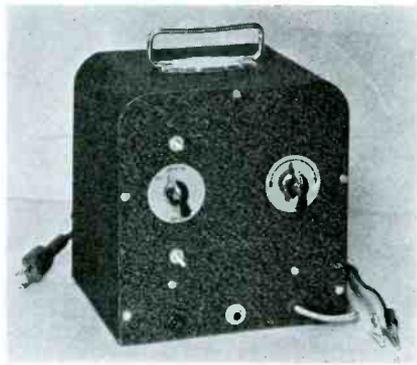


Fig. 1. A simple and inexpensive frequency standard can be set with an accuracy of 1 part in 200,000 against WWV.

and then obtain further check points at higher frequencies. The procedure is as follows: The signal generator output is fed into grid No. 1 of the 6SA7. The signal from a 100-kc oscillator standard is fed into grid No. 3 of the same tube. In the plate circuit of the tube there will be the sum of the frequencies from the 100-kc standard and the frequency from the signal generator. There will also be the two individual frequencies as well as the difference between them. If the frequencies are near enough together or if their harmonics are sufficiently close together, the difference frequency will produce an audio note which is amplified by the 25A7G and is readily audible in head phones. If the signal generator is emitting a 100-kc signal (and of course this should be an unmodulated signal) and the standard oscillator is producing a 100-kc signal (this is unmodulated when the phones are plugged into the jack), zero beat (zero signal) will be obtained between these two due to fundamentals of the two being mixed in the 6SA7 tube. However, if the signal generator when set to the 100-kc mark on the dial is actually producing a 101-kc signal, the difference between the two will produce an audio note of 1 kc which is heard in the phones. The signal generator frequency can then be varied slightly to obtain zero beat and the corresponding point on the dial noted. If the frequency of the signal generator is varied to 125 kc, the fourth harmonic of this frequency will be 500 kc and this will beat with the fifth harmonic of the 100-kc oscillator so that zero beat can again be

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obtained. In a similar manner the third harmonic of 133 1/3 kc will beat with the fourth harmonic of the 100-kc standard and thus can be accurately determined. The second harmonic of 150 kc will beat with the third harmonic of the 100-kc oscillator, etc. Thus, by means of a standard frequency such as 100 kc, numerous calibration points may be obtained on any variable oscillator.

• • • **nomograph**

Some of these beat notes, due to harmonics, may not at first be readily recognized and it is believed that the nomograph shown in Fig. 3 will be of great interest in helping to identify these beat notes.

On the graph, harmonic numbers of the 100-kc oscillator are plotted along the horizontal axis while the fundamental frequency in kc of the oscillator being checked is plotted along the vertical axis. A series of oblique lines are drawn which represents harmonic numbers of the variable oscillator. We shall call these oblique lines the "harmonic lines of the variable oscillator" and refer to them as the "fundamental line," the "second harmonic line," etc. To obtain an idea of the working of the graph, supposing we consider the variable oscillator to be set at 500 kc. At this position, the fundamental of the variable oscillator will beat with the fifth harmonic of the 100-kc standard. This is shown by the intersection of the fundamental harmonic line" with the ordinate (vertical line) drawn through the fifth harmonic point of the 100-kc oscillator. In this position, it can also be seen that the second harmonic of the 500-kc oscillator will beat with the tenth harmonic of the 100-kc oscillator as denoted by the intersection of the second harmonic line with the ordinate through the tenth harmonic of the 100-kc oscillator. Similarly the third harmonic of the variable oscillator will beat with the fifteenth harmonic of the 100-kc oscillator, the fourth harmonic of the variable oscillator will beat with the twentieth harmonic of the 100-kc oscillator, etc. Notice that all of the harmonics of the variable oscillator will zero beat with some harmonic of the 100-kc standard so that absolute zero beat will be obtained in the phones when perfect synchronism is reached.

Now as to the use of the chart in determining the beats produced as the variable oscillator is advanced from, say 500 to 600 kc. In making this analysis, one restriction on the chart which differentiates it from an ordinary graph must be borne in mind. This is that beat notes will occur only where a harmonic line crosses a vertical line drawn on an integral harmonic number of the 100-kc oscillator. This is obvi-

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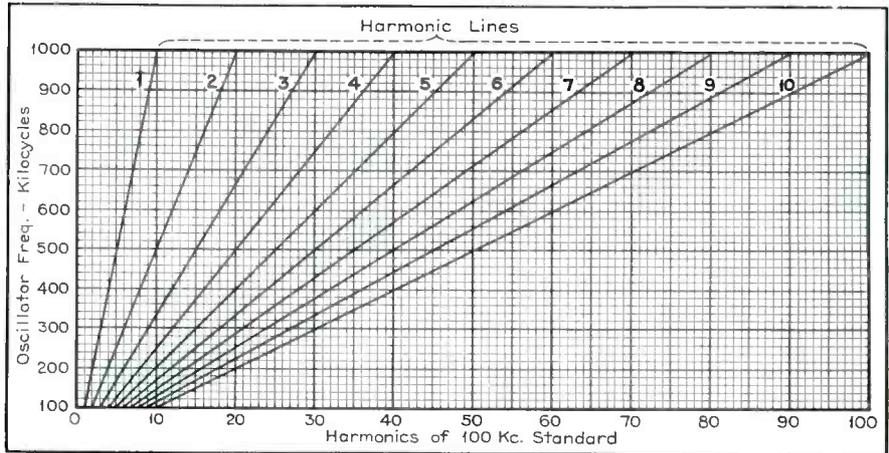


Fig. 3. The fundamental of the signal generator is shown by the intersection of the harmonic line with the ordinate (vertical line) drawn through the particular harmonic point of the 100-kc standard.

ous since there is, of course no such thing as the 6.3th harmonic of an oscillator. Starting at 500 kc with the variable oscillator, it can be seen immediately that the fundamental of this oscillator will beat with the fifth harmonic of the 100-kc standard as denoted by the intersection of the "fundamental harmonic line" with the vertical line through the point which denotes the fifth harmonic of the 100-kc oscillator. Now let us see where a frequency slightly greater than 500 kc intersects the "harmonic lines" at a point where the "harmonic line" crosses a vertical line. The ninth "harmonic line," we find, crosses a vertical line corresponding to the forty-sixth harmonic of the standard oscillator at a point where the variable oscillator is set at 511.1 kc. The fifth "harmonic line" shows that when the variable oscillator is tuned to 520 kc zero beat will be obtained. The fourth "harmonic line" shows that 525 kc will give zero beat with the twenty-fifth harmonic of the 100-kc standard oscillator, and the third "harmonic line" shows that 533.1/3 kc will zero beat with the sixteenth harmonic of the standard, etc. Some of the higher order beat notes are very weak (that is, the audio signal is weak as zero beat is approached) and their identity is greatly facilitated with reference to the curve.

At first glance, the chart given may appear to be limited because it only extends to 1000 kc. The range of the chart may, however, be increased indefinitely by merely multiplying both ordinates and abscissae by any desired number. For instance, multiplying the ordinates by 10, we can obtain the beats of an oscillator which goes to 10 mc. To do this it is necessary to consider that the harmonics of the 100-kc oscillator shown must also be multiplied by 10. Thus the tenth harmonic ordinate becomes the one hundredth harmonic, etc.

It is also possible to use the graph for

obtaining possible beats with a 1000-kc standard. This is done by using the same harmonic numbers along the horizontal axis and by multiplying the variable frequencies plotted along the vertical axis by 10. The same harmonic lines may be used and the same extension method employed as previously described. For instance, the tenth harmonic of 5 mc will give zero beat with the fiftieth harmonic of a 1-mc standard, etc.

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● Redesigned, retooled, the new Meissner Vibrator is now ready to take its place with the other quality Meissner Products.

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Mail FREE Copy of current VIBRATOR REPLACEMENT GUIDE TO:		
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counter and  
portable types

## THE NEW WESTON

MODEL 777

### TUBE and BATTERY TESTER

tests batteries as well as tubes under load  
... gives dealers and servicemen extra  
sales and profit from battery replacements!

Look at the figures . . . and the opportunity. Over 30% of radio sales in recent months were portable battery or combination receivers. And sales still mounting and expected to climb in 1940. Here's a real opportunity to sell tubes . . . and a *brand new market in the sale of battery replacements.* » » » To enable servicemen and dealers to 'cash in' on this opportunity, WESTON provides the Model 777 Tester . . . which not only provides a thorough check on all tubes, but also tests *all* radio batteries under load. The "Good — Replace" scale instantly indicates whether the battery delivers sufficient potential to insure good reception. (Such a test cannot be made with ordinary battery testers, nor with high current drain meters.) » » » So with Model 777 you not only will be equipped with a tube checker that will remain serviceable for years, but you also will be able to check the batteries while you are checking the tubes. No tube checker today is up-to-date unless it supplies this battery test . . . enables you to give complete customer satisfaction, with *more profit for yourself.* Be sure you have complete information on Model 777. Return the coupon today.

#### Tests Radio Batteries Under Correct Load

"Good — Replace" indications based on battery manufacturers' standards and receiver requirements for good reception.

- ★ Tests high filament voltage tubes (up to 117 volt types)
- ★ Tests Loktal tubes
- ★ Tests OZ4
- ★ Tests ballast tubes
- ★ Tests for shorts
- ★ Tests for noise
- ★ Tests open elements
- ★ Individual element test
- ★ Spare socket for possible future requirement
- ★ Large WESTON Meter

WESTON ELECTRICAL INSTRUMENT CORP.

604 Frelinghuysen Avenue  
Newark, New Jersey

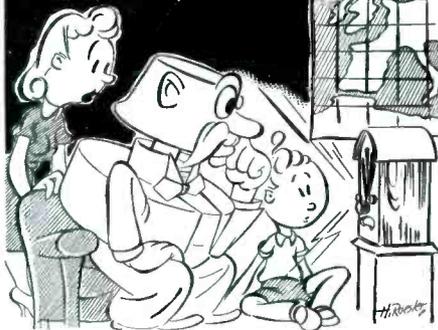
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## Europe "Clears thru" CENTRALAB

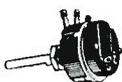


• Short wave reception really means something these days . . . and when it is a bit "frazzly" on the higher frequencies the Radio Serviceman comes into his own. The wise brothers carry Centralab "spares" for satisfactory replacement service, and please the most critical cash customers. So, if you would glean the golden harvest these days . . . see your jobber for sufficient Centralab replacement parts.



### Ceramic Capacitors

Where permanence of temperature compensation insure and retain stability of frequency in oscillator circuits.



### Volume Controls

In standard or midget . . . a low noise level and smooth attenuation insure reception of faint signals.



### Wave Change Switches

Multi-point switching for wave change or tone control . . . with positive low resistance contact.



### Toggle Switches

In communication receivers . . . with crystal filters and wherever delicate supplemental tuning is involved.

# Centralab

DIV. of GLOBE UNION INC.

Milwaukee, Wisc.

## PUBLIC ADDRESS

(Continued from page 469)

action to the observers outside the window through the media of microphones on the desks to pick up the voices, and contact microphones attached to the two typewriters. The output level at the Jensen 15-inch dynamic mounted just above the large window is set to overcome the local noise and thus provides a highly realistic and effective demonstration. An oscilloscope permits the audience to see as well as hear the relative sound peaks of the two machines.

### • • • animated sound

One variety of sound equipment that finds considerable favor with exhibitors is the Robophone, a system in which all sorts of mechanical operations are controlled and perfectly synchronized with sound from records. Thus, robots are made to move their lips in unison with the recorded speech accompaniment, pictures are turned over or stereopticon views are changed as a recorded description of them proceeds, doors or panels are opened to disclose exhibits (see Fig. 16) being described, etc. In fact, there are almost no synchronized mechanical operations that cannot be accurately controlled in any predetermined manner by this equipment. For sound specialists who are not familiar with the possibilities of the Robophone it is something that would bear looking into.

### • • • showman's ingenuity

A Bogen Model D-28 sound system makes possible one very striking stunt, Fig. 17, found in the Eastern States Ice Association exhibit in the Foods North Building. Here is a large ice-box with the glass door of the center section showing the ice and food compartments. In the block of ice appears a 10-inch image of an actual living Ice Princess who is seen to move around and whose voice is reproduced through the speakers above. Later the Princess in person steps out of a side door of the box to continue her act from a microphone out front. The visual part of the scene is worked by means of a series of lenses. It is really an astonishing presentation and even a grown-up is almost moved to believe in fairies when he sees it. Obviously the use of sound to bring the Princess' voice outside the box greatly increases the realism and effectiveness of the presentation. A stunt such as this should be easy for the sound man to sell to department stores, etc., for use as an attraction for the children during the Christmas shopping period and at other times as well.

The installations and applications that have been discussed and pictured here represent only a few of the many found

## WEBBER Testing Instruments

"years ahead in design"



### SERIES 200 TUBE TESTERS

Tests all the new tubes, including 117 volt tubes, dynamically. Factors of both mutual conductance and of emission are covered. Noise and other tests are included and choice of three meter sizes and four types of cases are offered. Series 200 includes six different testers ranging from \$29.95 to \$44.75.

**FREE!** Introductory offer! 80c retail quality screw driver, 8 inch transparent amber handle, 1/2 inch rust-resisting satin plate blade. Send only 20c in stamps to cover cost of mailing and handling.

WRITE FOR CATALOG 29-10



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1313 W. RANDOLPH ST. CHICAGO, ILL.

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**SPEAKERS  
— THAT  
VITALIZE  
— SOUND**



### PUBLIC ADDRESS REPLACEMENT SPEAKERS

PERMAG DYNAMIC ELECTRO DYNAMIC  
FROM 2" TO 14"

Improved in construction—now more sensitive and more profitable than ever before. Available—from the astonishing 2" Permrag up to the 14" Permrag or Electro Dynamic Unit. For Speakers That Vitalize Sound—Order Oxford Today!

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RADIO CORPORATION

915 W. VAN BUREN ST. CHICAGO, U.S.A.

at the Fair. But they should help to convey some idea of the variety, both practical and novel, that has found expression in these sound installations, contributing so much to the interest and effectiveness of exhibits. It can fairly be said that sound has widened the horizons of the exhibitor many fold and has made millions of Fair visitors more sound conscious. It is now up to the sound man to capitalize this start through the application of redoubled sales efforts. Not the least part of such effort should be the full exercise of imagination and ingenuity in finding new applications. It is hoped that the foregoing will prove helpful toward this end. The result will be not only an ever broadening market for sound equipment, but definitely reduced sales resistance.

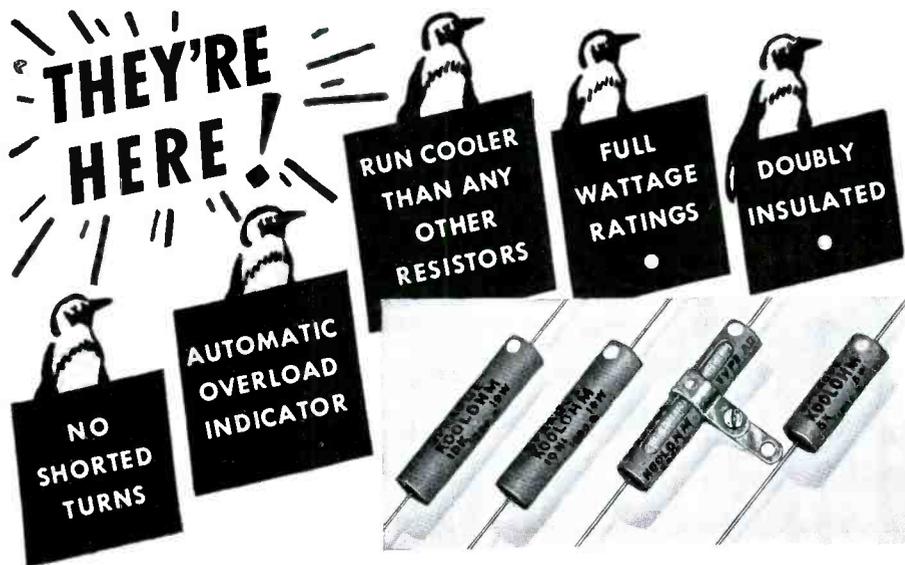
### HIGHER GOALS

(Continued from page 470)

New set sales mean, generally speaking, an increase in the quality of home reception. Keeping sets in American homes operating is vitally important to broadcast stations who realize that 85% of all radio homes in the United States are already equipped with one or more receivers. The conversion of non-radio homes would have inconsequential effect on broadcasters' rate structures because the addition of remaining non-radio homes would not noticeably increase buying power. The present non-radio homes exist because they simply have not the financial capacity to buy. Therefore, broadcasters will always want the best home reception it is possible to have and the burden of accomplishing this rests with the American Service Man. To that end, NAB members are cooperating with radio Service Men throughout the country by affording a special window trim to be used in their store windows. New sets are being displayed in radio studios from Baltimore to San Antonio and beyond for the benefit of listeners who are invited to inspect them. Even more active NAB participation is now beginning in the form of broadcast announcements that are being made periodically over the networks calling the listening public's attention to the fact that the station is in touch with reliable, qualified Service Men in that community and that by merely phoning to the station the listener will be advised as to how to reach that Service Man or service organization.

### BURGESS WINDOW TRIM

A Santa Claus window background, 33 by 48 in., in full color, is offered by the Burgess Battery Co., Freeport, Ill., with an assortment of flashlights and batteries. For further information write directly to Burgess.



## SPRAGUE KOOLOHM RESISTORS

*The Biggest Improvement in Wire Wounds in 20 Years*

Note the above exclusive features of Sprague Koolohm Resistors—and they're not all! The 9 points of outstanding Koolohm superiority also include:

- Larger wire size for every value.
- Every bit of wire insulated *before* winding with a new resistance coating—further protected by a dark brown ceramic outer shell. The only truly insulated wire wounds on the market.
- Non-inductive resistors—zero inductance at 50 mc. and distributed capacity of only 2 mmfd.
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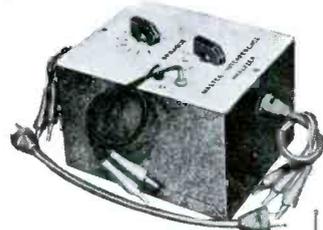
No cements or brittle enamels on Koolohms! Koolohm wire insulation allows units to be layer wound with larger wire. Values are guaranteed accurate to 5% or better, and remain constant. Now available in 5-watt fixed types; 10-watt fixed; 10-watt non-inductive and 10-watt adjustable. Sold at ordinary resistor prices. The greatest resistor buys on the market. *Your jobber has them!*

## CASH IN ON INTERFERENCE ELIMINATION



Now—it is made easy for you to build new business in a growing, non-competitive field! For years, Sprague engineers have been developing practical methods for eliminating man-made radio noise from every type of electrical appliance. The Sprague Manual of Radio Interference just off the press is the result. Tells you what to do and exactly how to do it. Easy to understand—indispensable in your work. 24 pages—fully illustrated—more than 50 diagrams. Only 25c net from Sprague jobbers or direct from us.

● Shown here are the new Sprague Master Radio Interference Analyzer (at top) and the new Sprague Interference Locator (below). Low in price—easy to use—fully practical. Write for details on the complete Sprague Interference Elimination Plan.



## SPRAGUE



### "SCOTCH" CONDENSERS



ATOMS  
MIGHTIEST  
MIDGETS  
OF ALL

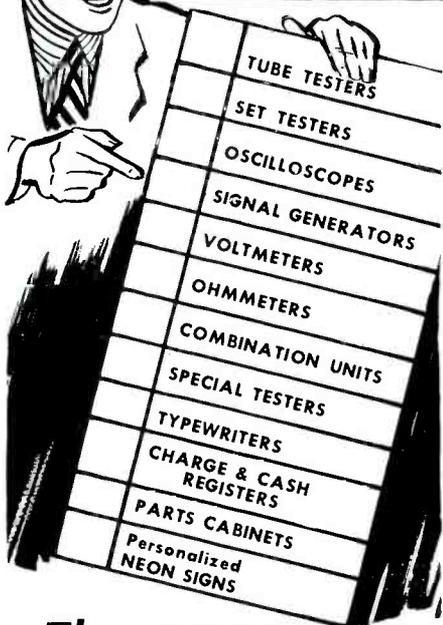
### Save Time, MONEY, SPACE . . .

It's not only Scotch money-saving instinct—it's good business that leads more servicemen to use more Sprague Atoms than any other midget dry electrolytics on the market today. Atoms are smaller—more dependable—made in more single and dual capacities—have lower leakage—withstand higher surges—are absolutely protected against blow-ups. Use 'em anywhere. Atoms stand the gaff!

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NORTH ADAMS, MASS.

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No matter what units you need to modernize your store and shop facilities, chances are you can obtain them easily and quickly merely by selling high-quality Arcturus Tubes! The Arcturus Equipment Deal, with Lower Down Payments and Lower Tube Requirements than ever offered before, was devised by Arcturus to help you do more business at a greater profit. It enables you to offer your customers Radio's finest Tubes . . . it gives you your regular tube profit . . . and, best of all, it gives you an EXTRA PROFIT in the form of modern store and shop equipment! Tube prices remain Standard—less standard discounts

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For your convenience this coupon can be pasted on a penny postcard

## BOOK REVIEW

PERPETUAL TROUBLE SHOOTER'S MANUAL, Volume X, by John F. Rider, published by John F. Rider, publisher, 404 Fourth Ave., New York City, 1939, 1664 pages, price \$10.00.

This year's manual presents the servicing data for more than 2600 receiver models, an increase of about 25% over last year's manual. This greater coverage, in 1664 pages, has been made possible through the condensation (and cross reference) of those portions of the data which are common to a number of models of a particular manufacturer's receivers. For example, instead of running the data on the automatic tuning system along with servicing information on each receiver in which it is incorporated, such material is given just once in that manufacturer's section and reference made to that page.

Another saving has been effected in many instances by lettering in voltage values on the schematics and alignment frequencies on the chassis layouts that show the location of the trimmers.

The 188-page cumulative index which accompanies the manual makes it possible for the Service Man to find information with a minimum of effort. Each bit of data in all ten manuals is listed. Not only are the chassis numbers cross-referenced to the model numbers, but if more than one model number is used with a chassis, these are listed numerically and referred to the lowest number of the group.

The "How It Works" section contains a theoretical description of the RMA system of television transmission and reception, wireless record players, radio facsimile, and frequency-modulation receivers.

An overall description of a television system occupies about one quarter of the book. This covers the problems of scanning and synchronization, the camera, and picture tubes, etc. Next the television signal itself is considered: the signal and sync pulses, frequency ranges, channel make-up, the RMA standard signal, etc. The remainder of the television section is devoted to those circuits with which the Service Man will have to deal, i.e. those in the receivers. A sufficient number of television receivers of different manufacture are covered in the manual proper, so that variations of the various circuits can be discussed and this portion of the book should prove of the greatest value. Circuits have been redrawn stripped of those components which are supplementary and not essential to a comprehension of the functioning of the portion of the circuit discussed in the simple text. Power supply circuits, antennas and their installation are also covered.

It is this reviewer's opinion that Rider's Volume X is as essential to the Service Man as a soldering iron or voltmeter.

G. B. R.

## ARISTON ELECTROLYTIC CONDENSERS

A newly developed line of by-pass and electrolytic condensers is announced by Ariston Laboratory, Inc., 4057 Diversey Ave., Chicago. P. H. Tartak, president of the company, states that a new etching process, to give uniform etched foil and extended condenser life, has been installed. A new catalog has been issued, for jobbers and Service Men, which lists a complete series of replacement condensers. Copies are available on request.

## THE NEW BROWNING FREQUENCY GENERATOR

(A 100-1000 Kc. Modulated Calibrator)



At last here is an accurate 100-1000 Kc. standard which is designed for spot checking frequencies of television or radio receivers at intervals of 100 and 1000 Kc., yet at a price which is within the means of the average pocketbook. A built-in mixing circuit is also provided for accurately checking at 100 and 1000 Kc. intervals the frequency of oscillators, signal generators, transmitters and other apparatus. Note these outstanding features:

1. Ingenious circuit gives unprecedented versatility.
2. Bed-rock stability on 100-1000 Kc. oscillator.
3. Audio modulation for accurately checking calibrations of receivers, etc.
4. 100-1000 Kc. oscillators readily adjusted to 1 part in 200,000 against WWV's frequency.
5. Adjustment of 100-1000 Kc. oscillators absolutely independent.
6. Built-in mixer circuit allows checking signal generators, oscillators, exciters, transmitters, etc.
7. Completely self-powered 110 volt AC-DC.
8. Phone Jack provided for accurate zero beat adjustment.

List price of completely built unit less tubes, \$33.00. **\$19.80**

NET PRICE . . . . .  
Also available in kit form, complete with instructions. List Price, less tubes, \$27.00. **\$16.20**

NET PRICE . . . . .  
If your jobber cannot supply you write us direct giving his name.  
**BROWNING LABORATORIES**  
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## Sound specialists are making money in P. A. with LAFAYETTE!



### GET IN THIS PICTURE!

Today, owners of stadiums, ballrooms, churches, department stores, offices, garages are sold on the importance of Sound. New outlets for P.A. sales develop every day! You can sell these—and profit more—with the Lafayette line for 1940.

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for every purse and purpose. Allied, too, Lafayette offers three lines—a DeLuxe, Standard and Economy to help you quickly turn prospects into customers, stock into cash profit. For there's eye appeal in Lafayette's packaged P.A.—and performance that can't be matched even at twice the low Lafayette price.

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Tear out coupon and mail for FREE catalog. See the world's most complete line of sound systems. Compare Lafayette feature for feature, dollar for dollar with any other P.A. Then, go to town with Lafayette—the money-making line in the low price field.

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Rush FREE 1940 Radio Catalog No. 78.

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If you want facts, not fantasy . . . performance, not promises . . . Close examination and actual experience with **PRECISION** instruments will prove conclusive.



## TUBE TESTERS

**Dynamic Mutual Conductance Tube Testers and Combination Set Testers—Five Basic Series—16 Types to Choose from with Prices Starting from \$29.95**

**★920** Combination Dynamic Mutual Conductance Tube Tester and 33 range AC-DC multi-range set tester. A complete single unit laboratory. Tests all new tube types and filaments to 120 volts. Tests AC-DC voltages to 3,000 volts, D.C. current to 12 Amps, resistances to 10 Megs, decibels to +64 D.B. All indications on large easy reading 4 1/2" rectangular D'Arsonval meter. 920P illustrated above.

**★922** An impressive tube merchandiser and set tester with attractive 9" 400 microampere rectangular meter. Electrical features and facilities the same as incorporated in Series 920.

**★910** Economically priced, yet incorporates same tube analyzing features as Series 920 but minus multi-ranges. Easy reading, full size 3" square type D'Arsonval meter.

**★912** Same tube analyzing features as Series 920 but minus multi-range features. Employs attractive 4 1/2" D'Arsonval type rectangular meter.

**★915** An impressive tube merchandiser incorporating a large 9" rectangular meter. Same tube analyzing features as Series 920.



## MULTI-TESTERS

**Modern Multi-Range Testers and Set Analyzers—6 Basic Series—15 Types and Combinations—Prices Start as Low as \$10.95**

**★852** 20,000 ohms per volt Rotary Selective Super-sensitive tester. 39 ranges including seven AC and DC voltage ranges to 5,000 volts, eight D.C. current ranges to 10 Amps, resistance ranges to 40 Megs, decibel readings to +69 D.B., and seven A.C. output ranges to 5,000 volts. Incorporates large 4 1/2" D'Arsonval type 50 microampere rectangular meter. Indicated for accuracy of measurements in high resistance and low current circuits employed in radio, television, sound on film, amplifiers, etc. 852P illustrated above.

**★844** 34 range Rotary Selective AC-DC Volt-Ohm-Decibel-Milliammeter including ranges to 6,000 volts A.C. and D.C. at 1,000 ohms per volt, 1 1/2 Amps D.C., 10 Megohms, -12 to +70 decibels. Incorporates large 4 1/2" D'Arsonval type 400 microampere rectangular meter. Physical appearance similar to Series 852.

**★862** A Laboratory Multi-Range Tester with large 9" 400 microampere rectangular meter and Remote Control Rotary Selective Unit. Electrical specifications same as for Series 844.

**★870** Complete, compact, Automatic Push-Button AC-DC Multi-Range Tester, with full size 3" square type D'Arsonval meter. Tests A.C. and D.C. voltages to 3,000 volts, D.C. current to 1.2 Amps, resistance to 5 Megs, decibels to +64 D.B. Size only 7 x 4 x 3 inches.

**★830** Compact D.C. Volt-Ohm-Milliammeter "Handi-Tester," fully rotary selective. Tests voltages to 1,000 volts, current to 250 Ma, resistance to 300,000 ohms. Incorporates large 3" square type D'Arsonval meter. Size only 7 x 4 x 2 1/2 inches.

**★"S"** Ultra-modern, completely Rotary Selective Socket Selector Unit, providing direct socket analyzing facilities without moving test leads.



## OSCILLATORS

**NEWTYPESIGNAL GENERATORS in keeping with latest receiver requirements**

**★E-200** Signal Generator incorporating the new "Precision A.V.C. Substitution System" allowing for simplification of alignment problems of the modern receiver without interfering action of the A.V.C. circuit. ● The ultimate in stability and accuracy, this instrument provides a combination of features not found in oscillators at even greatly increased prices. ● Full frequency coverage 110 Kc through 72 megacycles, guaranteed accuracy with ±1%. ● Over 5 feet of direct reading scale length on large 6" chrome dial and vernier. ● Variable Modulation Control 0-100%. ● Coaxial Output Cable with separately shielded, dual, positive acting R.F. attenuators. ● Separate sine-wave audio oscillator-modulator. ● Audio test signal from 0 to 60 volts. ● Each instrument individually calibrated. ● Housed in heavy gauge steel case, available for portable or panel mount.

**★E-300** Signal Standard — a NEW type of push-button operated service instrument, essential to rapid, accurate alignment of push-button tuned home and auto radios. A BROADCAST STATION SUBSTITUTE for any 10 desired frequencies providing complete independence of the Station Signal. Frequency range 550-1600 Kc. Highly stabilized 1N5 electron coupled oscillator, AIR-TUNED. Separate 1E4 modulator. Fully portable. Long lived battery operation. Complete Push-Button operation. No switches.



# PRECISION TEST EQUIPMENT

*Standard of Accuracy*

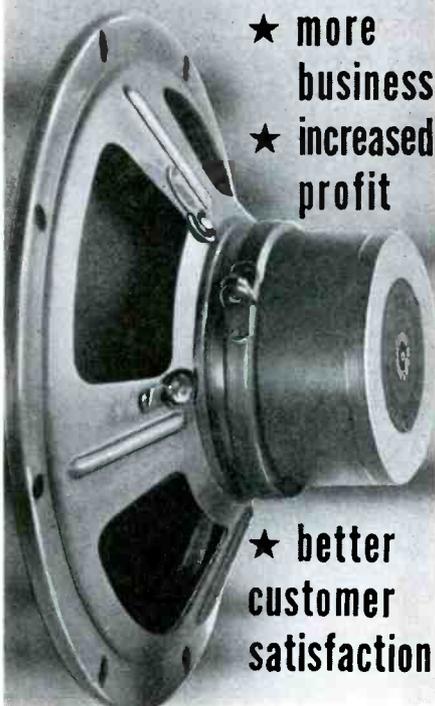
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**U**nknown, perhaps, to your customers, but vitally important to you, is the name of the speakers you use. Choose wisely, then . . . choose Cinaudagraph — the quality name to those "in the know."

Cinaudagraph draws upon an enviable fund of specialized knowledge in bringing you this complete line of quality speakers for every "replacement" and "sound" application. Yet they cost you no more!

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STAMFORD, CONNECTICUT**

## N. U. FOOTBALL SCOREBOARD

National Union Radio Corp. released to the trade a new football scoreboard sign produced in black, green and white 20 by 28 inches overall. The scoreboard provides for the listing of five sets of teams with team names, score by quarters, and final blanks finished in a special blackboard black paint which enables the dealer to write in the information in chalk and wash it off so it can be used week after week throughout the season. A space is also provided for the dealer to have his name lettered on as well as a space marked "Special" where the dealer or person displaying the board may write in a weekly merchandise special.

National Union football scoreboard signs are made available through National Union distributors at 50c each.

## WEBBER BULLETIN

Earl Webber Co., 1313 W. Randolph St., Chicago, have issued an 8-page bulletin illustrating and describing their latest test equipment for the Service Man. Copies may be obtained directly from Webber.

## RCA PARTS CATALOG

In their test equipment and accessories catalog for 1939-40, the RCA Manufacturing Co., Inc., Camden, N. J., have announced many new additions to the RCA test equipment, accessories and parts lines. The catalog contains a fully illustrated listing of accessories, parts and test equipment. In addition, it presents a 16-page index of the principal replacement parts for all RCA radio, Victrola and phonograph models of the past 5 years. Copies may be obtained directly from RCA at the above address.

## LAFAYETTE 1940 CATALOG

Radio Wire Television, Inc. (formerly Wholesale Radio Service Co., Inc.) announces that their 1940 catalog is ready for distribution. This 188-page radio buying guide contains 40 pages of home, portable and auto radios and accessories; 35 pages of p-a equipment; 50 pages of equipment, parts and tools for the Service Man and 30 odd pages for the ham.

A post-card addressed to the above company at 100 Sixth Ave., New York City, will bring this catalog to any reader of SERVICE.

## IRC APPOINTS BURLINGAME

Bruce O. Burlingame, 69 Murray St., New York City, has been appointed by the International Resistance Co., 401 N. Broad St., Philadelphia, Pa., to handle their fixed and variable resistors to the jobber and industrial trade in this territory.

## AEROVOX 1939-40 CATALOG

A 28-page 1939-40 catalog has been issued by Aerovox Corp., New Bedford, Mass. A complete choice of condensers is offered as well as essential resistors and test instruments, it is said. The various condenser types are classified and indexed for easy reference. Copies of the catalog may be obtained directly from Aerovox.

## ALLIED 1940 CATALOG

Allied Radio Corp., 833 W. Jackson Blvd., Chicago, have issued a 204-page Fall-Winter, 1940 catalog. Over 15,000 radio parts are listed in the general section covering every conceivable need, it is said. Copies may be obtained directly from Allied.



## ...the Complete Line

Servicemen—save time, simplify work, satisfy the customer and make a profit. Stancor offers you all this with their complete line of merchandise. Read these facts:

STANCOR offers the only complete line of transformers available from one source.

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## STANDARD TRANSFORMER CORPORATION

1500 NORTH HALSTED STREET—CHICAGO

## RECEIVER TRENDS

(Continued from page 477)

array is used in localities with very high noise level and low signal strength. This type of antenna provides great sensitivity, strong and sharp discrimination against electrical and reflective interference as well as increased directivity in pickup. All these types of antennas are erected parallel to the ground and at right angles to the direction of the transmitter.

### • • • communications receivers

A discussion of this type could never be considered complete without including the group of communication and high-quality short-wave receivers built primarily for short waves and used by many thousands of transmitting amateurs and fans. Hallicrafters, Hammerlund, Howard, National, RCA and Radio Manufacturing Engineers do the bulk of this business. The trends are toward better stability, more band spread, smoother controls, accurate calibration, variable selectivity with razor sharpness for c-w signals to broad high fidelity, higher image rejection and signal/noise ratios and output meters (called S meters) that operate over a wide range of signal voltages. Hallicrafters start with the Sky Buddy at \$29.50 (see Fig. 18), which has 6 tubes, 4 bands, 44 mc to 545 kc, speaker, phone jack, avc and send/receive switches, separate band spread dial, beat oscillator with pitch control and provision for d-c vibrator operation. More expensive models have an output meter, crystal filter and many refinements. Besides their standard receivers covering these same specifications, RME has a portable-emergency receiver, a high frequency converter and a pre-selector giving additional amplification and image rejection to a value approximating 50,000 to 1! National has a wide range of receivers and gadgets including receivers in several price classes, but specializing in very high quality products for commercial installations such as government services, airports, marine installations, etc. A 1-10 super-regenerative receiver covers all wavelengths from 1 to 11 meters. National also makes a complete line of parts too numerous to consider here. Hammerlund's receivers are also in the upper price brackets and they, too, have a large number of parts available. Howard's receivers are more in the popular price class. Other manufacturers offer a considerable number of converters, pre-selectors, filters of all sorts and antennas and other accessories that would fill an album.

Self-contained. Portable. Easy to operate. Weighs but 4 1/4 lbs. Complete with tubes.

• Checks capacity of condensers at r.f. without removing them from circuit.

• Aids in aligning r.f. and i.f. circuits, tracking super-het. oscillators, etc.

• Used in aligning broad and narrow u.h.f. amplifiers. Aids tuning of wave traps and image-rejection circuits.

• Identifies harmonics of frequency standard in precision frequency calibration of radio equipment.

• Checks resonant points of chokes, shorted windings (unused coils), etc.

• Checks natural period of antennae and r.f. transmission lines, etc.

• Handles many other functions, particularly with auxiliary equipment.

• Just imagine testing condensers right in their own circuit—no disconnecting, no unsoldering. A truly *radio* test which checks at the operating radio frequencies for capacity, opens, shorts, intermittents. Also tests inductances, circuits, frequencies, resonant points, etc., etc.

No matter what test equipment you may already have, you simply cannot get along without the L-C Checker, now that it is available. It will save you much time, money, comebacks, because it *tests condensers and inductances and circuits at work*.

Best of all, the L-C Checker costs only \$29.50 net! That makes it doubly indispensable to you.

**Ask to See It . . .**

Your local AEROVOX jobber will gladly show you the L-C Checker. Look at it. Try it. Ask for descriptive bulletin—or write us direct.



**AEROVOX CORPORATION**  
*New Bedford, Mass.*



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See the Simpson line today and you will decide to put it to work tomorrow. You and Simpson Testing Equipment can form a mighty profitable partnership right now.

SIMPSON ELECTRIC CO., 5214 Kinzie Street, Chicago

**SIMPSON**  
INSTRUMENTS THAT STAY ACCURATE



**MODEL 260**

• The new high sensitivity set tester for television and radio servicing. At 20,000 ohms per volt this instrument is far more sensitive than any other in its price range. Six voltage ranges, both A.C. and D.C. Resistance ranges from 1/2 ohm to 10 megohms. Current readings from 1 microamp to 500 milliamps. Your Price... **\$27.50** (Similar model, No. 215, with 5,000 ohms per volt at \$22.85.)

**MODEL 440 "TEST MASTER"**  
Tests All Tubes—Tests All Circuits

**Filament Voltage 1.5-120 Volts**  
Has screen fluorescence and angle test; hot cathode-leakage neon test; "high sensitivity" neon short check; "good" and "bad" scale, and "noise test." Has six A.C. and D.C. voltage ranges; three resistance ranges; four milliamperage ranges; six Decibel ranges. Your price... **\$59.00**



**MODEL 325**  
**GIANT TUBE TESTER**  
Tests All Tubes—Filament Voltage 1.5 to 120 Volts

• Has handsome, illuminated red, green and black scale on a silver etched dial with full 9-inch meter. Checks each element separately; shorts on dual-sensitivity neon tube. Has jack for noise test. Convenient drawer contains neat tube charts. Meter is reversible for horizontal use. Wings available for rack mounting. Your price... **\$34.50**



**MODEL 320**  
**GIANT SET TESTER**

• First set tester with giant (9-inch scale) illuminated dial meter—first with 50 ranges which include nine voltage ranges both A.C. and D.C.; six milliamperage ranges; five resistance ranges; four capacity ranges; seven Decibel ranges. Test leads, insulated for 5,000 volts furnished with each tester. Entirely A.C. operated—no batteries needed. Wings are available for rack mounting. Your Price... **\$37.50**

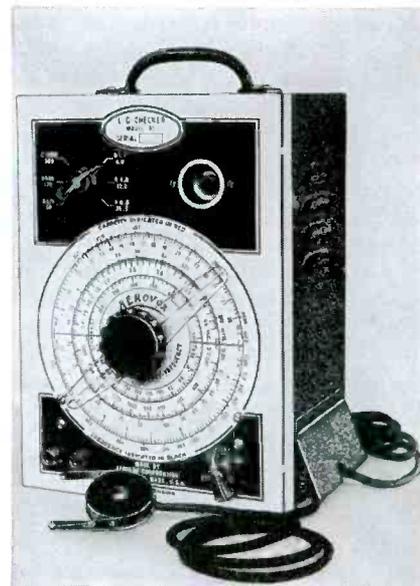


**THORDARSON 14-WATT AMPLIFIER**

The newest Thordarson 14-watt amplifier features a multiple stage inverse feedback circuit and low-frequency booster which is said to provide linear response to 15,000 cycles with the addition of accentuated bass. Additional information may be obtained directly from Thordarson.

**AEROVOX CONDENSER CHECKER**

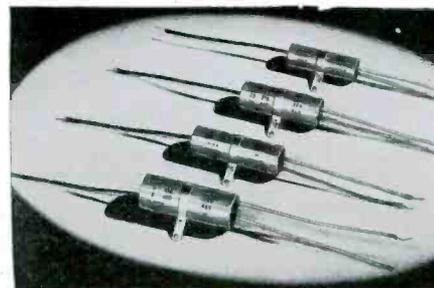
A radically new means of testing condensers and coils in the r-f range under actual operating conditions is offered in the Aerovox Model 95LC checker, it is claimed. The instrument determines the effectiveness



of a condenser or coil without disconnecting it from the circuit in which it is used. It is self-powered. Additional information may be obtained directly from Aerovox Corp., New Bedford, Mass.

**C-D DUAL ELECTROLYTICS**

The Cornell-Dubilier type BRL dual electrolytic condensers are said to offer convenience and security of parts mounting. These tubulars are dual units with a common negative and a mounting strap around the center. They are available in 6 popular capacity ranges from 25 to 450-volt ratings. Additional information may be obtained directly from Cornell-Dubilier, South Plainfield, N. J.



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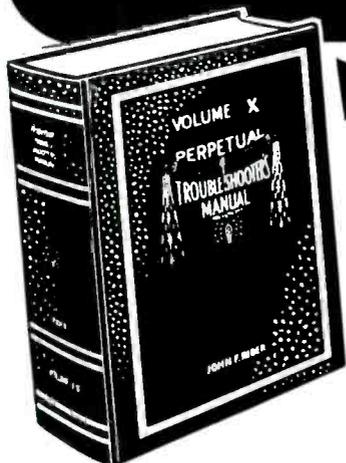
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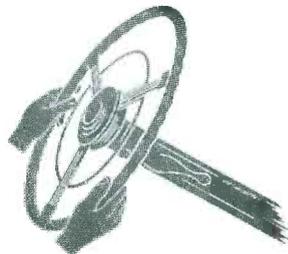
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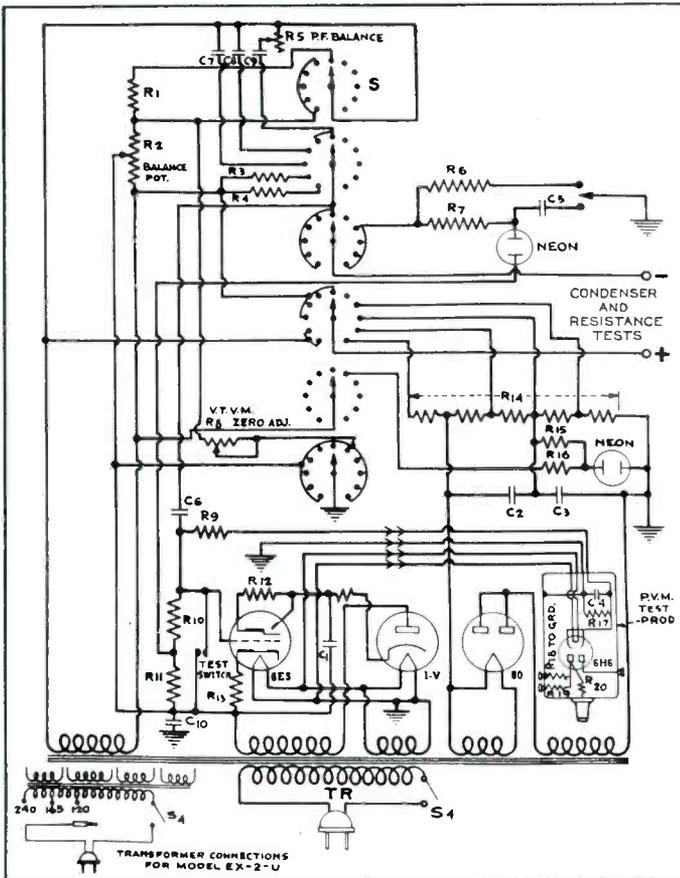
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## SOLAR EXI-60, EX2U EXAM-ETER

THE Solar Exam-eter can be used to determine the electrical characteristics of electrolytic, paper, mica, trimmer and air dielectric condensers. In addition, it can be used as a peak reading voltmeter.

Condensers may be tested for capacity, leakage, opens, shorts, intermittent operation and power factor. The peak voltmeter is provided for measurements of circuit voltages to determine the required voltage rating of condensers to be used for replacement. It can also be used for checking output levels and signal voltages at various points of a receiver. The leakage tester can be used for checking insulation resistance and as a circuit tester.

Fig. 1. In addition to the usual condenser and resistor tests, the Solar EXI-60, EX2U Exam-eter can be used as a peak reading vacuum-tube voltmeter. A 6E5 visual indicator tube is used as a null indicator during the condenser and resistor tests.

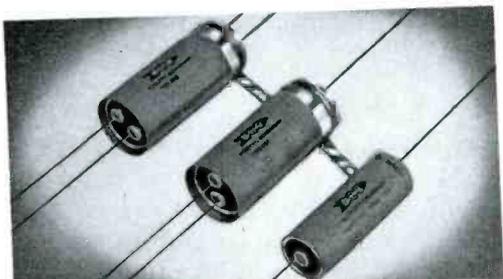
Calibrated markings on two color scales are provided for measurement of capacity and resistance. These tests are made on a Wein bridge with direct reading ranges and by multiplying the scale reading by the bridge constant. The power factor of electrolytic condensers including a-c or motor starting types can be read directly from a scale which is calibrated zero to 50% power factor. The capacity range of this instrument is from 0.00001 mfd to 1600 mfd and the resistance range is from 50 ohms to 7.5 meg.

Two test terminals are provided on the panel for resistance, capacity and leakage tests. The switch within the Exam-eter connects the unit under test to the proper circuits.

The leakage test portion of the instrument consists of a d-c power supply and a neon lamp. A switch is provided with volt-



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The MICAMOLD TUBLYTIC SERIES, in singles, duals, triples and quads, are ideal for replacements in radio receivers. There are ratings and combinations for all applications.

Ask your jobber for the MICAMOLD TUBLYTICS . . . also the BALLASTRONS, UNICORDS, KODACAPS and other components that make successful servicing simpler.

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Owensboro, Kentucky

# KEN-RAD

DEPENDABLE RADIO TUBES

age settings for 100, 200, 400 and 600 volts. Operation of the neon lamp is indicated effectively through the visual indicator tube. The circuit diagram of the Exam-eter is shown in Fig. 1. The circuit elements involved in the peak voltmeter are shown in Fig. 2.



Fig. 3. The hinged cover of the Exam-eter is removable and reveals the sloping panel and the direct reading scales.

A fixed d-c reference voltage is supplied by the drop across the neon lamp N. A part of this voltage appears across the potentiometer R2. The applied test voltage is rectified by the 6H6 tube in the test prod and appears as a d-c voltage across condenser C4 in the prod. Due to the action of the rectifier, C4 charges up to the peak value of the applied test voltage, regardless

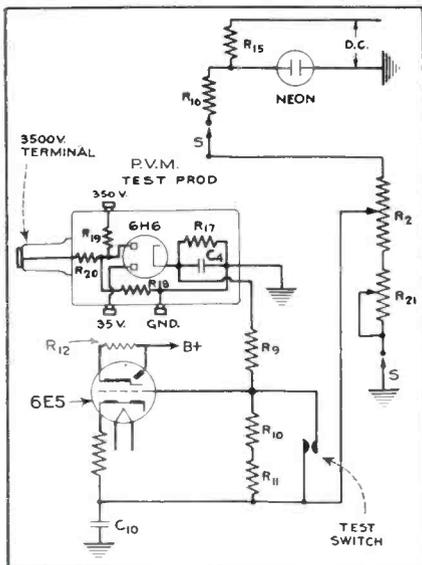


Fig. 2. The peak reading voltmeter is provided for determination of the required voltage rating of replacement condensers. The useful range is from 3 to 3,000 volts.

of its wave form.

The d-c voltage across C4 is compared with the known voltage across the potentiometer R2 by means of the 6E5 null in-

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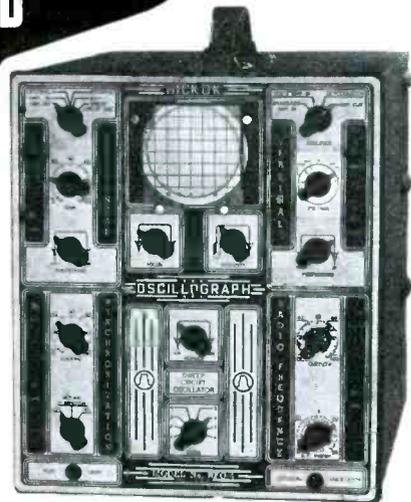
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dicator. When the voltage between the grid and cathode leads to the indicator tube is zero, the potentiometer setting is at a voltage equal to that developed across C4.

When the grid and cathode leads to the 6E5 have zero voltage across them, the operation of the test switch button will result in no change in the indication of the eye. Under all other conditions, there will be either an opening or closing of the eye.

The useful range of the voltmeter is from 3 to 3000 volts. The short test leads, low input capacitance and high input resistance of the test prod permit use of the voltmeter in the broadcast and short wave communications bands with little error and slight loading on the test circuits.

A zero adjustment of the voltmeter is provided to compensate for contact potential in the voltmeter tube.

• • • specifications

Finish: Polished wood.

Controls: Range selector, capacity balance potentiometer, power-factor balance, vtm zero adjuster, test switch, and off-on switch.

Ranges: Capacity: 10 mmid to 600 mid; Voltage: 3 to 3000 volts. (Two scales in each case.)

Power supply: EX1-60; 60 cycles, 115 volts; EX2U: 25 to 60 cycles, 110 to 220 volts.

Tubes and functions:

Null indicator: 6E5.

Vacuum tube rectifier: 6H6.

Rectifier for leakage, etc.: 80.

Rectifier for 6E5: 1V.

Dimensions: 12 x 10 3/4 x 9 1/2 in.

Weight: 10 lbs.

Price: \$39.50 net.

# OHMITE

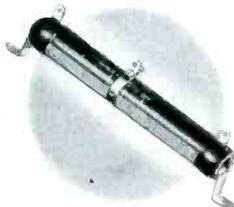
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### MEISSNER VIBRATORS

G. V. Rockey, vice-president and general sales manager of Meissner Manufacturing Co., Mt. Carmel, Ill., announces a Meissner vibrator which life tests and field reports prove to be of exceptional value, it is said. Additional information and characteristics may be obtained directly from Meissner.

### TURNER DYNAMIC MIKE

A new Turner Mike is being offered by the Turner Co., Cedar Rapids, Iowa. The unit, Model 33D has an output level of -54 db, at high impedance and a frequency range from 40 to 9000 cycles, it is said. It is streamlined and is supplied in satin chrome finish. Additional details and prices may be obtained directly from Turner.



### SIMPSON GIANT INSTRUMENTS

Simpson Electric Co., 5214 Kinzie St., Chicago, have introduced two new Giant instruments in their Model 320 Set tester and the Model 325 tube tester. The set tester incorporates 50 ranges in a-c and d-c volts (at 1000-ohms per-volt), ohms, amperes, milliamperes, microfarads and decibels. A 9-in meter is used with an indirectly illuminated face.

The tube tester also features the 9-in meter and is capable of testing loktal, single-ended, bantam, midget, gas rectifier and standard tubes as well as plug-in resistors, Christmas tree and pilot lamps.

### ADMIRAL AEROMETER

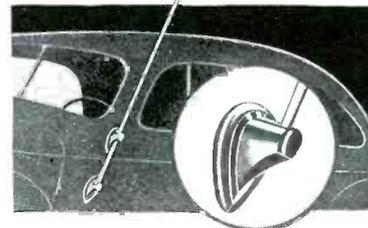
The Continental Radio & Television Corp., 3800 Cortland St., Chicago, have developed the Admiral Aerometer, a device for checking the normal sensitivity of loop operated receivers. The Aerometer is a loop radiator to be used in conjunction with a signal generator as a signal source for loop measurements. The device is completely shielded and surrounding objects have no effect upon measurements made through its use, it is said. Additional information may be obtained directly from the manufacturer.

### CLARION 16-WATT AMPLIFIER

The Clarion Model C418 sound system uses push-pull 6L6s in the output stages; is capable of delivering 16 watts rated, 18 watts peak; has a microphone input gain of 113 db and a frequency response from 40 to 9500 cycles, it is said. The system is complete with two 10-in pm speakers, wall baffles, microphone, floor stand and cables. Further information may be obtained by writing Transformer Corp. of America, 69 Wooster St., New York City.



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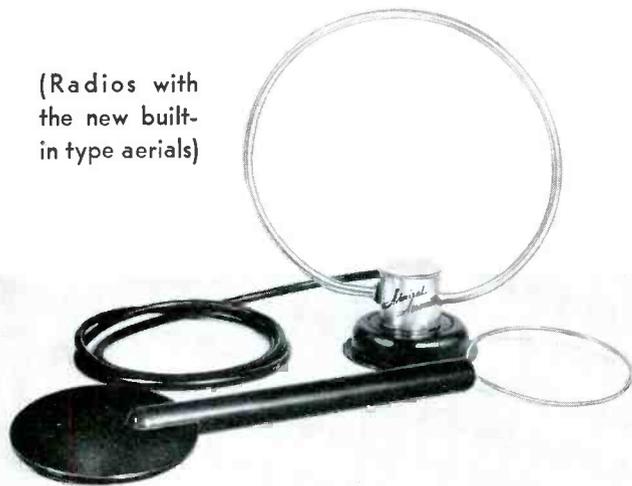
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INSTRUMENT CO.  
DAYTON, OHIO



**JACKSON**

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(Radios with the new built-in type aerials)



With This Easy-to-Use Tester

## Admiral Aerometer

**S**TANDARD procedure for checking receiver alignment is impractical with radios having the new built-in type loop antenna. Any direct connection with the signal generator loads the antenna coil so that alignment is incorrectly made with an added capacity which is subsequently removed.

To meet the demand for a simple, yet accurate method of aligning loop receivers, our laboratory has developed the Admiral Aerometer. It consists of a *shielded loop radiator* and a *reactance wand* for checking the tracking of loop receivers.

**Completely Shielded**

Connected to the output terminals of a test oscillator, the loop radiator transmits the signal to the loop antenna and the sensitivity of the set is checked in the usual manner. Since the radiating loop and connecting

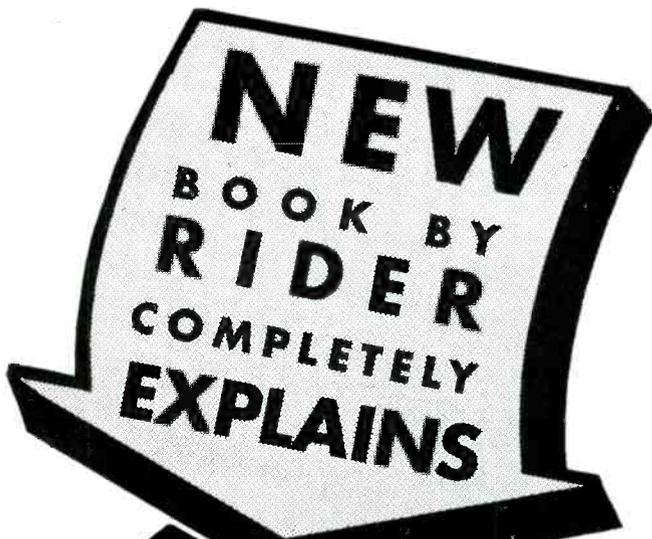
cable are completely shielded, there are very few precautions to observe.

The reactance wand has been developed to indicate the mistracking of sets having a cut plate gang (similar to the action of a tuning wand on a conventional antenna coil). The wand is brought close to the antenna coil—first one end and then the other. If the output of the set drops in both cases, the set is tracking perfectly. The wand is marked on one end "Increase Antenna Capacity" and on the other "Decrease Antenna Capacity."

The Aerometer is substantially constructed of finest materials and workmanship characteristic of Admiral Radios. If your jobber cannot supply you, order direct from our factory.

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## WESTON TESTER

The Weston Model 777 tube and battery tester has provisions for battery tests under load, as well as for normal tube tests. The condition of a battery is indicated on a good-replace scale with the cut-off point



set at the proper value. Five pin jacks are provided for different battery voltages encountered. The tube tester permits the testing of octal, loktal, single-ended and other recent type tubes as well as 4, 5, 6 and 7-prong standard types, gas rectifiers, plug-in resistors, etc. Additional information may be obtained directly from Weston Electrical Instrument Corp., Newark, N. J.

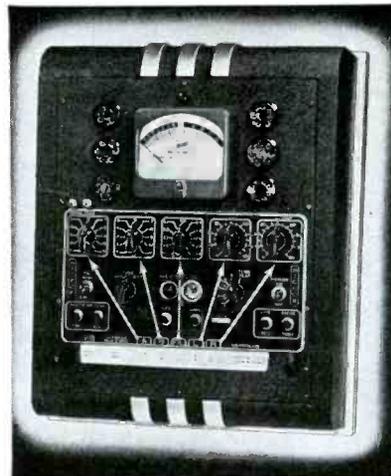
## SPRAGUE CONDENSERS

Three new spade-bolt type tubular cardboard dry-electrolytic condensers announced by the Sprague Products Co., North Adams, Mass., are designed to serve as universal replacements for the many condensers of this type used in modern re-

ceivers. The units include an 8-8 mfd and an 8-16 mfd at 450 volts, working and a 12-16 mfd, 200-volt type. These and other Sprague condensers are described and illustrated in the 1939-40 catalog, copies of which may be obtained directly from Sprague.

## HICKOK TUBE TESTER

The Hickok Model 530 tube tester measures dynamic mutual conductance of tubes



on three ranges of micromhos. A dual reading scale also indicates good, bad or doubtful. The instrument will test octal, single-ended, loktal, gas rectifier, and standard tubes as well as plug-in resistors and pilot lamps. For more complete details write to Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, Ohio.

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**ERWOOD 18-WATT AMPLIFIER**

Erwood Sound Equipment Co., 224 W. Huron St., Chicago, have announced their Model 2418A, 18-watt amplifier, shown in



the accompanying illustration. The unit has two input positions as well as a tone modifying control and variable output impedance. Seven tubes are used. Additional information may be obtained directly from the manufacturer.

**ASTATIC CRYSTAL PICKUP**

The Astatic Model AB8 crystal pickup has been made available. This unit fea-



tures spring-axial cushioning, Astatic type B cartridge with ebonite waterproof coated

crystal element, Tru-Tan offset head to reduce tracking error, threaded stud base for single hole mounting and a new diecast arm. Response of the AB8 may be altered according to requirements by a slight modification of the input circuit or by the use of Astatic's E4P tone equalizer. Astatic Microphone Laboratory, Inc., Youngstown, Ohio.

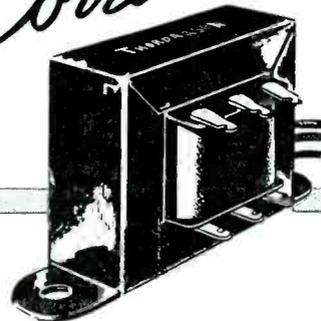
**RADIO CITY MULTITESTER**

A new pocket-sized multitester meter has been announced by Radio City Products



Co., 88 Park Pl., New York City. The unit, Model 412, employs a 400-microampere meter and covers 13 ranges in d-c volts, ohms, milliamperes and microamperes. Additional information on this and other Radio City test instruments may be obtained directly from the manufacturer.

*Correction!*



We recently stated that the THORDARSON T-13S38 was the largest selling replacement transformer in America. However, careful research and a more thorough study of the records shows us the statement would be more accurate if changed to read, "The THORDARSON T-13S38 is the largest selling replacement transformer in the WORLD!"

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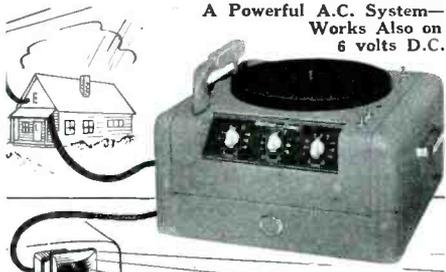
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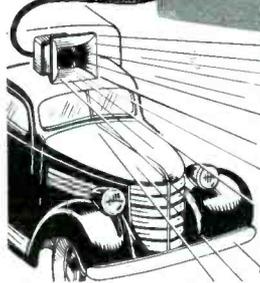
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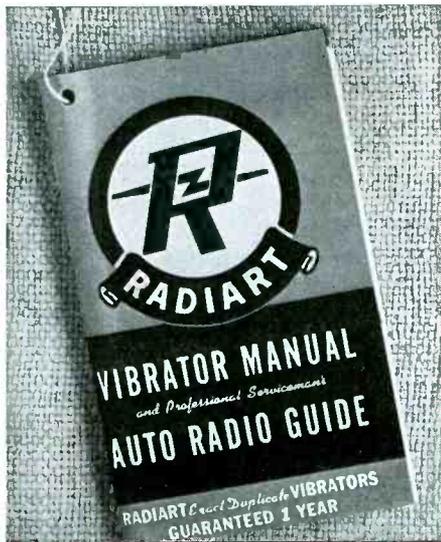
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